# CURRENT SCIENCE

Vol. XII] APRIL 1943 [No. 4

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## SCIENTIFIC UTILISATION OF INDIAN OIL-SEEDS

OIL-SEEDS form a valuable part of the annually recurring agricultural wealth of this country. Out of an estimated area of about 300 million acres of land under actual cultivation, forming roughly 25 per cent. of the geographical area of the Indian Empire, about 60 million acres are under oil-seed crops. Besides, the 90 million acres of Indian forests also yield, as minor forest produce, commercial quantities of important oil-seeds. The approximate acreage and annual output of the more abundant oil-seeds are given below:—

| Oil-seed | Acreage in millions of acres | Output in millions of tons |
|---|---|---|
| Cotton .. .. | 25·0 | 2·0 |
| Groundnut .. .. | 10·0 | 3·3 |
| Mustard and rape group | 7·0 | 1·0 |
| Linseed .. .. | 5·0 | 0·5 |
| Gingelly .. .. | 5·0 | 0·6 |
| Castor .. .. | 2·0 | 0·2 |
| Cocoanut .. .. | 1·4 | 1·4 |
| Poppy .. .. | 0·5 | 0·2 |

The less abundant, but nonetheless valuable commercial oil-seeds comprise Mowra, Nigerseed, Safflower, Kokum, Domba, Dhupa, Chaulmogra, Neem, Ritha, Cashew, Honge, Kusum, Hemp and many others.

The present annual output from all these sources may be roughly taken as 10 million tons, which may be approximately valued at 100 crores of rupees. One of the first questions which strikes a rational publicist in relation to this large annual output is how far this agricultural wealth has been harnessed to satisfy the demands of internal consumption or of a policy of sound national economic prosperity. At any rate, the proper utilisation of this precious raw material in the best interests of Indian agriculturists and their professional requirements is a responsibility which no enlightened government or patriotic businessman can shirk.

A rational plan of utilisation of oil-seeds should commence with a systematic assessment of the scientific value and industrial potentiality of the three main components of every commercially important Indian oil-seed, *viz.*, (1) the shells and husks, (2) the oils and fats derived from the kernels, and (3) the residual oil-cakes. Of these, systematic analyses have so far been mainly undertaken on the fatty oils prepared from the seeds or seed-kernels.

As many as 1,000 species of oil-seeds belonging to about 125 Natural orders of plants have been analysed for the content and characteristic properties of their oils and a few valuable guiding principles discovered, showing remarkable similarities

in the scientific and industrial potentialities of oils belonging to the same natural order of plants. It is needless for the purpose of the present article to describe in detail either the different modes of extraction of oils from oil-seeds or the variety of treatments and processes to which oils are subjected in the various industries connected with their multifarious utilisations at the present time. One need only peruse the following list of their industrial uses:—

(1) Refined salad and edible oils including hydrogenated vegetable ghees, (2) Toilet, Textile and Liquid Soaps including Turkeyred Oils, (3) Illuminating Oils, Candles and Liquid Fuels, (4) Glycerine and Explosives, (5) Paints, Varnishes, Lacquerware, and Plastics including rubber substitutes, (6) Shoe and Leather-dressing Greases and Polishes, (7) Simple and Compound Lubricants, (8) Linoleum and Waterproof Fabrics, (9) Medicinal Oils and Pharmaceutical Compositions, (10) Various Fine Chemicals including valuable Synthetic Perfumes.

This list is gradually expanding with the advancing scientific knowledge concerning fatty oils. Though a given oil may not be adaptable to every one of the above uses, it is possible by suitable treatment with physical and chemical processes, to utilise the product for several of the purposes. It is exactly in this direction that there is immense need and scope for a systematic investigation of the industrial possibilities of every indigenous fatty oil of commercial importance.

Compared to available scientific knowledge concerning fatty oils, that relating to oil-cakes is deplorably meagre. The industrial and scientific value of oil-cakes is in no way inferior to that of the related fatty oils. In some respects, their importance as edible foods, as cattle fodder, and as fertilisers is incomparably greater than that of the oils themselves. Many of them are in the first instance capable of yielding by suitable methods of extraction a variety of valuable fatty, glucosidic, alkaloidal, and resinous drugs and detergents, without affecting their further utility as rich sources of vegetable proteins, carbohydrates and mineral constituents. A systematic scientific investigation of our oil-cakes has unlimited scope and will amply repay the time and energy spent on it.

The position regarding the scientific knowledge of shells and husks of oil-seeds is even more precarious than that of oil-cakes. Sufficient is, however, known regarding a few of these, *e.g.*, cotton-seed hulls, cocoanut and cashew shells to warrant the prediction that many of these, on suitable treatment, may prove to be rich sources of phenols, of furfuraldehyde and of kindred chemicals, which are essential ingredients for a "synthetic plastics industry". The ashes of many of these hulls and shells are rich sources of valuable potash and phosphates. It is needless to stress the importance of a systematic research into their scientific and industrial potentialities. At present they are either used as cheap fuel or as doubtful fodder.

Properly utilised, the raw oil-seeds estimated at 100 crores of rupees can easily be made to yield a variety of finished products worth at least 500 crores of rupees. The above forecast is based on a review of several years of research experience with indigenous oil-seeds and related products, and it should convince our leading statesmen and industrialists that there is an urgent need in India to-day for one or more co-ordinated Provincial Institutes devoted exclusively to fundamental and systematic investigations into the scientific and industrial value of indigenous oil-seed products. Provision will have to be made for a periodical demonstration and dissemination of the resulting knowledge among our industrially gifted artisans through the media of local vernaculars.

Without such a concentrated endeavour and organisation on our part, our agricultural activities will only maintain our countrymen as permanent "Hewers of Wood and Drawers of Water", leaving the more remunerative aspects of the industrial utilisation of our raw materials in the hands of the more enlightened and actively organised industrialists of the other countries. One therefore trusts that our business magnates and administrators will rise equal to the occasion and enable Indian scientists to contribute their best for our national industrial prosperity.

## SIR S. S. BHATNAGAR, Kt., O.B.E., D.Sc., F.Inst.P., F.I.C., F.R.S.

FELLOW-SCIENTISTS in India and chemists in particular will learn with pardonable pride and sincere satisfaction the happy news of Sir S. S. Bhatnagar's

recent election to the Fellowship of the Royal Society of London. He has the distinction of being the first Indian Chemist to receive this signal honour. Readers of *Current Science* are fully aware of his numerous fundamental contributions in the field of colloid, magneto- and photo-chemistry. He and his pupils have in no small measure been responsible for the establishment of a number of schools of physico-chemical research now flourishing in several parts of India. More recently his activities in the field of applied chemistry both as Professor of the Panjab University and as Director, Board of Scientific and Industrial Research, have been crowned with striking successes and all these have received due and grateful appreciation not only by the Government of India but also by industrialists, fellow-workers, and learned societies.

Sir S. S. Bhatnagar was born in 1895 and had his education in Lahore, London and Berlin. On several occasions he has represented India at many of the international congresses of pure and applied sciences. His dynamic, inspiring and genial personality, have won for him a wide circle of disciples, friends and admirers.

Sir S. S. Bhatnagar has been one of the most enthusiastic and whole-hearted supporters of *Current Science* since its very inception and has actively encouraged and guided it in a number of ways. We consider it a great privilege to offer him our heartiest felicitations on the occasion of his election and wish him many years of active and greater service in advancing the cause of science and industry.

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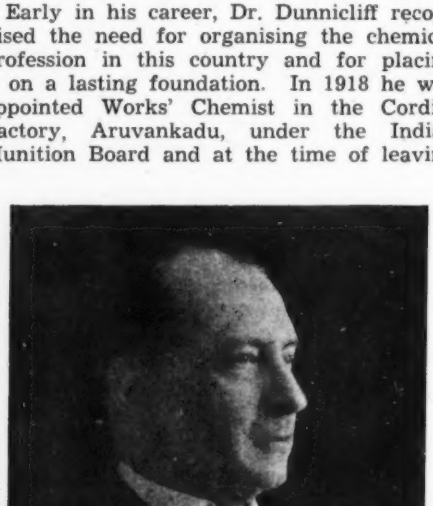
## DR. H. B. DUNNICLIFF, C.I.E., M.A. (CANTAB.), Sc.D. (DUBLIN), F.I.C., I.E.S.

DR. HORACE BARRATT DUNNICLIFF, Chief Chemist, Central Revenues Chemical Laboratory, whose retirement from service was recently announced, has been a leading personality of the chemical profession in India during the past three decades. After a distinguished university career in London and Cambridge, he arrived in India in 1908 as Professor of Science in the M.A.O College, Aligarh. In 1914 he was appointed to the I.E.S. and seconded as Professor of Chemistry in the Khalsa College, Amritsar. His services were transferred to the Government College, Lahore, in 1917, and as Professor of Chemistry, and sometime Principal of the College, Dr. Dunnicliff found opportunities not only to carry out original investigations in the fields of inorganic and analytical chemistry but also to organise and develop the Central Revenues Chemical Service in this country. The organisation

of this service is perhaps his most outstanding achievement and marks the fruition of his unremitting efforts to obtain the recognition of the Government for his profession.

Early in his career, Dr. Dunnicliff recognised the need for organising the chemical profession in this country and for placing it on a lasting foundation. In 1918 he was appointed Works' Chemist in the Cordite Factory, Aruvankadu, under the Indian Munition Board and at the time of leaving



it in 1921, he was in charge of the laboratory and with characteristic ability, he directed a large number of chemical investigations of great value to the munition production. At the instance of the Government of India, Dr. Dunnicliff prepared in 1928, a comprehensive scheme for testing laboratories at the major port towns of India and Burma and when it was decided by the Government to give effect to his scheme in 1929, Dr. Dunnicliff reverted to the Government College, Lahore, and with the approval of the Punjab Government, established the chemical laboratory of the Central Board of Revenue in the Government College, Lahore. The work of this laboratory, which included the whole field of Revenue Chemistry, assumed enormous proportions and necessitated the organisation of a laboratory exclusively devoted to this work. The Central Revenues Chemical Service was instituted in 1937 at his instance and 14 permanent and temporary gazetted officers and a number of chemical assistants are now engaged in customs work under this service in the laboratories at Calcutta, Bombay, Madras, Karachi, Ghazipur, Sambhar Lake and New Delhi. The Central Revenues Chemical Laboratory was established in 1939 and Dr. Dunnicliff assumed Scientific Control of Central excise work as Chief Chemist in 1939. Dr. Dunnicliff's name is intimately associated with this big organization and he will be ever remembered in this country as the founder of the Central Revenues Chemical Service and Laboratory.

Dr. Dunnicliff has to his credit a large number of original research papers in inorganic and analytical chemistry. His recent work on the by-products of the Salt Industry has attracted world-wide attention. In 1939, he was awarded the C.I.E. in recognition of his work for the Central and Punjab Governments. He is Chairman of the Naturally Occurring Salts Committee of the Board of Scientific and Industrial Research, and member of the Drugs Advisory Board and the Drugs Supply Committee of the Government of India. His association with *Current Science* dates from the time of its inception and the *Journal* has found in him an able guide and an enthusiastic supporter. Dr. Dunnicliff is an accomplished musician and has taken active part in a number of social and sports activities, particularly in amateur theatricals. We wish him a long and happy life in his retirement.

# SIR M. VISVESVARAYA ON APPLIED RESEARCH IN RELATION TO INDUSTRIAL DEVELOPMENT AND POST-WAR RECONSTRUCTION

ADDRESSING the Sixth Annual Meeting of the Court of the Indian Institute of Science, Sir M. Visvesvaraya, the President of the Court, re-emphasised the fact that the Institute was founded in order that its activities might be devoted to securing for India the material benefits expected to follow from the close association of scientific research with the industries of the country. He added. "Such was also the primary object for which this Court was established. I trust it is permissible to hope that in future the new Court will devote two or three days of its time at each annual session for enquiring into, and discussing, the affairs of the Institute and for reviewing the progress made in science and research both at this Institute and in other institutions in the country. By doing so, they will be not only setting a healthy precedent but will also be serving the interests of science and industry in the country as a whole."

Reviewing the progress achieved during the preceding quinquennium, Sir M. Visvesvaraya remarked, "a casual examination of the annual reports of the previous years will disclose the fact that industrial research which was the main purpose for which the Institute was established had been allowed to fall into background. How this came about is explained in my previous addresses. A Joint-Committee of the Council and the Court was constituted in March 1940 to suggest measures to give industrial research its proper place in the scheme of things, and some of the suggestions recommended by that Committee are now being slowly given effect to. It has been found difficult to make rapid changes because the funds available are limited and it has not been practicable to divert the money already earmarked for other useful objects. Steps are being taken to follow a consistent policy in future and to strengthen the industrial research side of the work until at least half the regular expenditure of the Institute is separately devoted to it.

"The Quinquennial Reviewing Committee which functioned in 1936 was the last of its kind. The Committee due in 1941 was not appointed on account of the war. I believe there is no necessity for appointing any more reviewing committees. A better plan in future would be to depute one or two professors to foreign countries as often as funds permit to study world progress in the subjects in which training is given in the Institute. The reviewing committees did useful work when the Institute was still young but the men who conceived the idea and shaped the original plan could not have intended that the Institute should remain in leading strings for all time.

"The budget estimates of income and expenditure which were presented to the Court at its first meeting in March 1938-39 were likely to amount to Rs. 6,00,354 and Rs. 6,05,868, respectively. The corresponding figures of income and expenditure in the revised estimates for the year 1942-43 are Rs. 9,55,017 and Rs. 11,30,105. The opening balance in the former budget stood at Rs. 5,34,373 and in the latter Rs. 4,70,413. The reduction of about Rs. 64,000 was due to the increased cost of apparatus and materials in war time and also to the extra sums that had to be spent on applied research in order to obviate the cutting down of other useful collateral activities that had sprung up. Several new schemes have been initiated, income has grown, and expenditure on work done during the lifetime of the last Court has increased by more than 80 per cent. All this is a distinct sign of prudent administration and progress."

He then referred to the higher types of technological instruction which was being recently imparted at the Institute. "The first of these developments was a course in chemical engineering, started in 1940-41, in which systematic instruction is being imparted. Equipment of considerable value required for this section has already been secured, and the syllabus is being constantly improved and brought up to date. This development was necessary to give preliminary training to students coming fresh from the laboratories of theoretical sciences before they embark on industrial research. I understand that the course has been quite popular with the freshmen admitted to the several departments of Chemistry.

"A second development is the course newly started from January 1943 for post-graduate training in Aeronautical Engineering. This is the first scheme of its kind in India. The Government of India have sanctioned a capital grant of Rs. 1,25,000 for the construction of a Wind Tunnel and the accessory laboratories, and a recurring grant of Rs. 41,800 for the salary of the staff and working expenses. These grants have been supplemented by a capital grant of Rs. 1 lakh from the funds of the Institute for equipping the laboratories. The aeronautical engineering industry has a great future before it and there is every prospect that the graduates who have chosen this post-graduate course will not lack profitable employment.

"Our thanks are due to Sir John Higgins, Mr. W. D. Pawley and Mr. L. C. McCarty for the valuable work they have rendered to the Institute in the planning and equipment for this course. Sir John Higgins, the Chairman of the Board of Directors of the Hindustan Aircraft, Limited, in a message to the Factory *Gazette* for February 1943 gives a very hopeful account of the progress of the local factory. He is of opinion that the work of the employees of the Company has now a scope far beyond the original aims set before them and he goes on to add: 'I look forward confidently to the time when this factory will compare favourably with the best aircraft factories in America or England.'

"It may be of interest to mention in this connection that Mr. W. D. Pawley, the American expert of the Bangalore Aircraft Company, has offered a scholarship of $3,000 a year for four years to students of this Institute, tenable at an American institution for higher studies in aeronautical engineering."

Continuing he said, "another important departure from routine developments is the projected establishment of a chair of Applied Mechanics and Automobile Engineering together with the nucleus of a research laboratory for the work of the professor to be appointed. This is due to the munificence of the Government of Mysore who have given the Institute a capital grant of Rs. 1 lakh and a recurring grant of Rs. 15,000. Provision is made in the budget for 1943-44 for starting work on this course.

"I brought to notice last year that the Institute did not possess the facilities of staff necessary to help large-scale or key industries. It is equipped to a certain extent for work in chemical industries but even in that sphere facilities for large-scale chemical industries are lacking. Both the Pope Committee and the Sewell Committee have recommended that the creation of a mechanical engineering laboratory should constitute the very first item in the Institute. The war that is going on is a mechanical engineers' war and if this Institute is to be of material help for war effort or for safeguarding the defences of the country, a department of Applied Mechanics should be started, Applied Research should be materially strengthened, and a research workshop added to form an integral part of both."

Discussing the present deficiencies and wants of the Institute, Sir M. Visvesvaraya said, "This Institute has not yet cultivated sufficiently closer relations with heavy industries so far, and no attempt has been made to establish Research Fellowships for heavy industries.

"Information and data pertaining to the leading key industries are being collected in the office of the Institute but the progress seems to be slow. It will be slow until an officer of the grade of an Assistant Professor is made definitely responsible for developing this activity.

"In last year's session of this Court, I pleaded for the setting up of a large engineering workshop and laboratory in order that the Institute may be able to handle satisfactorily many of the important problems that arise from time to time in mechanical engineering, electrical engineering, and heavy chemical industries. This will require substantial grants both capital and recurring; say, a capital grant of Rs. 10 lakhs and a recurring one of Rs. 2 lakhs. It is hoped that the Government of India will find the necessary funds. Help in this respect may be also available from the Indian States and the leading industrialists in the country. Not until adequate provision is made for the efficient engineering workshop and laboratory, can the Institute be said to have become a real home of industrial research.

"It is hoped that the policies and aims of the Institute will be clearly defined and a plan of work for the next five years determined by the Governing Council under the

advice of the Joint-Committee already referred to.

"Oftentimes, work in the field of pure research is of a routine character. This type of pure research is better left to institutions which are not so well equipped as this Institute is. Work in this Institute should be concentrated, mainly, though not altogether, on two or three specific objects, namely, technological instruction of the highest grades, research in heavy industries whether newly projected or already in operation, and theoretical research of a fundamental character.

"Since science is advancing very fast, closer co-ordination of duties between the members of the staff and orderly development of work on a plan in all the departments are *sine qua non*.

"If all the above-named deficiencies and wants are to receive prompt attention and the original intentions of the Founder faithfully given effect to, the best course would be to appoint a Committee of three members including the Director to watch the interests of the Institute on behalf of the Governing Council and keep the latter correctly posted in matters which it should know in order to exercise effective supervision and control. Each member of this Committee, other than the Director, may hold office for a couple of years and one of the two members may be elected every year jointly by the Council and the Court. The two members should be paid an honorarium or fee to ensure disciplined adherence to regulations on their part. This Committee of three should be of the nature of a specialised staff charged with the duty of keeping a watch on the progress of science and research both within and outside the country, of keeping an eye at the same time on the day-to-day needs of the Institute, and of continuously submitting proposals and programmes for improvement and reform as required. Since the Council meets only three times a year, a change of this kind seems absolutely necessary in order to do away with the hesitancies, delays and mistakes of the past. This is one of the principal measures needed to make the Institute a self-governing and self-improving institution."

In the course of the address he outlined the activities of the Board of Scientific and Industrial Research. He said: "On 2nd April 1940, the Government of India announced the establishment of the present Board of Scientific and Industrial Research. The creation of this Board was a happy move. It was expected that thereafter there would be a satisfactory co-ordination of work between the pure science research worker, the industrial scientist and the industrialists throughout the country. At commencement the services of research workers were utilised only for war work and the industries entrusted to the Board were all of a minor character. I understand that in recent months research in, and manufacture of, heavy chemicals are being encouraged, but the co-ordination of research work which is going on in all parts of the country, and which was considered important three years ago, has not yet been brought about.

"The Director of Scientific and Industrial Research and some of the members of the Board are scientists of acknowledged capacity and initiative. Some of the Committees appointed seem to have taken a serious view of their responsibilities and passed resolutions in favour of practical action in connection with the following among other industries:—

Internal combustion engines, Fuel research, Metallurgical industries, Dye-stuffs, Glass and refractory materials, and Manufacture of Industrial plants.

"Government have so far not shown much inclination to encourage the establishment of any of these industries. On the other hand it is understood that instructions have been issued to the Committees to confine their attention to the technical aspects of their problems and not to express views regarding administrative support or action, such as, protection, subsidies, etc., needed to establish the industries.

"I understand that another important resolution has been passed by the Council of Scientific and Industrial Research recommending the establishment of four research laboratories on an all-India basis, namely, a national chemical laboratory, a national physical laboratory, a fuel research laboratory and a metallurgical laboratory. It is hoped that preparations will be set on foot and necessary funds provided to give effect to this resolution.

"The latest move by the Council of Scientific and Industrial Research is the compilation and publication of a Dictionary of Raw Materials of India, embodying all

available knowledge of such materials. This is doubtless a satisfactory step, although a more urgent compilation, and a more useful one, needed is the collection and compilation of industrial statistics. In the absence of statistical measurement, it is feared Government themselves have no precise knowledge of the true industrial situation in the country."

Concluding Sir M. Visvesvaraya added, "The provision newly made for technological instruction of the higher grades is a notable event in the history of the Institute. Industrial research is also making some progress but it is yet far from what it should be. It is hoped the demand for more rapid progress will be recognised and that adequate provision will be made therefor in the proposed five-year plan which is at present under the active consideration of the Council.

"As regards research in India as a whole, it is satisfactory to learn that the Council of Scientific and Industrial Research has done some work for the war. But the co-ordination of research activities in all parts of the country which was to be one of its principal functions has not received much attention. At first only small industries and minor chemicals were allowed to be handled; latterly, however, heavy chemicals are also coming into favour. Discoveries and inventions are opening up a New Era of Engineering but there is no sign that research in relation to heavy engineering industries is making any progress at all in India outside the purely military establishments.

"I have had occasion from another platform to bring to notice the restrictions and limitations to which heavy industries have been subjected in India as compared with the phenomenal developments that have taken place in countries like Canada and Australia during this war. Till recently research was also treated in the same restrictive spirit. We have seen that several important recommendations made by the committees of the Council of Scientific and Industrial Research in favour of heavy industries, like the internal combustion engine, have not been accepted or even noted by Government. It cannot be said that an industry to manufacture internal combustion engines is not a vital necessity in any country or that it is not needed in India. I understand, however, that private establishments are attempting its manufacture with some success.

"It must be recognised that many industrialists and tradesmen have profited by the business done in textiles, raw and semi-raw materials and other war supplies, but it is a recognised economic axiom that *production of goods and services for war do not contribute to a country's economic welfare.*

"There is too much secrecy; no intelligent exposition of policies is available particularly in regard to industries. No official in high position ever gives a comprehensive interpretation of the views of Government, what they propose to do and why their policies and procedure are so different from those followed in any progressive country or even in the self-governing dominions of the British Commonwealth. There is no directory for war work or for civilian industries. Whatever attempts are made are fragmentary. The Governments of countries like Australia, Belgium, Russia and Czecho-Slovakia have set up offices in India to carry on their propaganda in this country. They issue News-Sheets regularly to acquaint Indians with what they are doing in their respective countries, whereas we do not get to know what our Government are doing in our own country. No stock-taking is done here, no review is attempted, of the industrial and economic affairs of the 390 millions of the population of India.

"As regards post-war reconstruction, although a beginning was announced and a Committee and Sub-Committees were appointed so far back as October 1941, no reports of those Committees have seen the light. What work the Committees did, whether they did any work at all is not stated. When the Committees began work, industries were excluded from their purview. All these are unusual practices under any Government. Such trends discourage enterprise and even preparations for post-war work. The appointment of a new set of Committees for post-war reconstruction has been announced within the past few days but that is also of the traditional type. No clear statement is made of the aims, or economic policies Government have in view.

"Contrast this attitude with these two statements picked out at random from the latest News-Sheet—*Astral News* for March 1943—just published in Calcutta:

Mr. Makin, Munitions Minister, said 'that Australian industry had been revolutionised to provide the maximum war effort.'

Dr. H. V. Evatt, another Minister, stated: 'Post-war reconstruction like the war task will consist in assuring that the country's economic resources are fully employed. They must be directed primarily for purposes which is Australia's obligation to achieve: namely, economic security and rising standards for all ..... Preparations in this respect will not retard but assist the war effort.'

"I am not pointing to any casual mistakes or omissions which in times of crisis like this are inevitable, but am referring to policies which seem deliberate and which threaten to cause permanent injury to the interests of our vast Indian population.

"I have had to refer to industries on this occasion because the main object of this Institute is to promote industries by means of research and there is a close interdependence between industries and research. It is needless to state that industrial research will have no value or importance if industries themselves are neglected or starved. Since at the present time, Government have taken control of almost every activity in the country, they owe a duty to the public to explain their policies and justify their inaction in respect of these three developments, namely, industries, industrial research for peace-time needs, and post-war reconstruction—as compared with what is happening under other Governments in the British Commonwealth. In the absence of such a statement, the future which India has to face, when the time for post-war reconstruction arrives, will be viewed by many thinking persons in this country with anxiety and apprehension."

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# DAIRY INDUSTRY AND ITS FUTURE

BY

NOSHIR N. DASTUR

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THE value of annual contribution of the bovine population to Indian economic wealth has been assessed at a colossal figure of one thousand crores of rupees. Of these, at least one-third is due directly to milk and milk products. Cattle maintenance is thus of great importance to India. It supplies not only a vast deficiency in our nutritional requirements but it is closely connected with the national economy. In spite of its magnitude, the present state of the dairy industry in India is rather sad. It is still steeped in orthodox sentiments, no attempt being made to fit in with the changing times and conditions. It is one of the most unorganised industries of the country and is carried out on individualistic basis. It is only a fortunate coincidence that the Indian populace is subconsciously aware of the nutritional importance of milk and its products.

In the past, on many an occasion human-made catastrophes have proved blessings in disguise. For example, it required the last Great War to teach the English farmers the benefits of properly organising their dairy industry and since then the development has been tremendous. In most of our urban centres, the situation is almost parallel to that existing in England at the time and considering the high prices the farm products fetch at present due to the war, it is to be hoped that this will provide a suitable opportunity for organising the dairy industry of this country on which a wider structure could be built later.

The prime function of the dairy industry is to produce enough milk to satisfy the needs of the country. The present production can at least be increased six-fold to achieve this end. This increase in milk market should no doubt bring in its train a better living standard for those engaged in this industry. Increase in production of milk is closely linked up with the number of the cattle population. India is in a paradoxical position that it has more cattle than it needs. India possesses about a third of the total cattle population of the world, yet the annual output of milk is hardly

12 per cent. of the whole. The average production of her animals is nearly one-fifth of those in New Zealand and one-eighth of those in Denmark. For milk production, food and right type of food, has to be provided to these animals. The present conditions in India do not permit of this maintenance of such a large number of stock. Unless this simple fact is realised, the dairy industry cannot make any progress. To-day India possesses about 100 million acres of land classified as "waste generally unsuitable for cultivation". There is no doubt that with the return of better times serious attempts will be made to utilise at least a part of this waste for growing food crops. The other logical solution is to dispose off a substantial portion of the present unthrifty stock. Their existence only means maintaining two half-starved animals where one should suffice. This subject is at present bound up with sentiment and it is also the bottle-neck which progressive forces in the country should try to break.

Before a nation-wide culling programme could be undertaken a simple system of recording the performance of each animal is essential. On this depends a rational distribution of the available foodstuffs and breeding of better generations. There is no doubt that by better selection, the average yield of our stock could be considerably raised. India depends on buffaloes to produce about 60 per cent. of her milk output. Yet at present there is far too little attention paid to the development of this class of milch animals. There are societies working in purely buffalo breeding tracts, which go out of their way to improve the milch qualities of poor-yielding cows, maintained mainly for draft purposes. The same energy and money spent in right directions can produce infinitely better results.

The greatest incentive to the production and improvement in the quality of milk and milk products is a guaranteed price. From the experience of other countries it becomes abundantly clear that unless a guaranteed price is allowed to producers, a large bulk of the profits is absorbed by the middleman who is little interested in rural conditions. In a big country like India, such measures are no doubt always difficult to be put in practice but with a little propaganda and organisation it is not impossible of achievement. At present, in the absence of such a scheme things sometimes go to ridiculous ends. For example, in most of the bazars, at least two types of ghee are sold, one for eating and the other for cooking purposes. There is usually a difference of at least 50 per cent. in the quality of the two. A section of the consuming public that cannot possibly afford to pay the price of genuine ghee likes to believe in this differentiation. It is, however, surprising how some of our health authorities also connive at this state of affairs.

One of the greatest handicaps in the successful development of the rural dairy industry on commercial basis is the lack of proper means of transport. Unless the villagers are well organised on co-operative basis the most profitable disposal of milk will always remain beyond the means of individual producers. It is possible that in the near future it will be realised that every village can have more and better milk and better health by maintaining a village co-operative dairy. For commercial exploitation of milk, quick transport of milk between the village and urban centres is an absolute necessity. Lack of proper transport compels the villagers to dispose off their milk by converting it into less remunerative products.

As in all other walks of life, the need for co-operative organisations cannot be over-emphasised. Production of milk, economically and in a reasonably clean state is an intricate process, starting from the production of right type of fodder to the disposal of the milk. Probably a small farmer never thinks about these details but the results of this *laissez-faire* policy are before our eyes. It is essential that every village or a group of villages, should learn the need for rearing their animals and producing their milk on a co-operative basis. After a preliminary experimental period, the producers will soon realise that they get a better value for their produce, their animals thrive better and the consumer slowly regains confidence in the quality supplied.

Before the desired quantity of milk can be produced in this country and utilised in the right way a little amount of education is also necessary. The farmer must be taught not to rely on straw alone as a food for his cattle. Application of existing knowledge for better conserving and producing good quality of feeding-stuff is

necessary. To do this he must also realise that every animal in his charge looks to a little corner in his field for its well-being.

At present the consuming public is inclined to lay stress on consumption of ghee much beyond what can be expected in return by way of nutrition. The remaining part of the milk is probably of greater nutritional value. If by spending the same money better nutrients can be bought they should learn to do it.

The economic importance of the dairy industry even in its present decadent state, as mentioned before, is enormous. One of its striking drawbacks is the total lack of interest shown in investigating the causes for many of the difficulties it encounters and in taking the help of modern scientific technic to overcome them. No doubt every ghee packer of importance maintains a room for housing a refractometer and one or two such other apparatus but that is mainly with the object of crossing the legal hurdle. One result of this policy is apparent. The Indian consumer is slowly losing confidence in the genuineness of the products of his own land and is prepared to pay fancy prices for imported articles. It is a tribute to other countries that they take pains to study the Indian requirements carefully and evolve technique to suit that demand. For example, a small import of ghee has already started. In course of time, if the warning is not taken, this is likely to oust a considerable proportion of the indigenous product. If the dairy industry is to advance and thrive, it must harness scientific knowledge to its needs.

Concluding, it may be stated that for the future development of the dairy industry a beginning has to be made from primary stages. Maintenance of just enough animals that can be properly fed, production of better quality of feeding-stuffs, co-operative dairy organisations, organised marketing and scientific research are a few points to be borne in mind, if it is desired to see commercial exploitation of milk a reality.

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## NATIONAL ACADEMY OF PEIPING

THE British Scientific Mission in China have just forwarded to us a little pamphlet, issued by the National Academy of Peiping, giving an account of the progress of the scientific activities under its auspices in war-time China, during the period 1937-42. The following is an *in extenso* extract of the report which will deeply interest fellow-scientists in this country and in other parts of the world.

"In accordance with an act passed by the Executive Yuan of the National Government, the National Academy of Peiping was established on September 9th, 1929, in Peiping, with the sole purpose of carrying out scientific researches and bringing about their applications. At its foundation, the Academy consisted of nine separate research institutes, namely, the Institutes of Physics, Radium, Chemistry, Materia Medica, Physiology, Zoology, Botany, Geology and Historical Studies and Archæology, and it used to have a staff of more than 200 members, including research professors, assistant research professors, senior and junior assistants and technicians, in addition to about thirty Chinese and foreign correspondent members. Contributions of all branches of work have been published in various languages, scattered throughout almost all the principal scientific journals of the world.

At the outbreak of the present war with Japan, Peiping was immediately taken over by the invaders; and we were then forced to suspend or relinquish our studies. However, in the midst of confusion and distress we succeeded in transferring a portion of the books and equipment of each of our institutes to the South and to places of safety. And, what was even more fortunate, within a few months after the war had reached a state of stabilisation, the Academy was able to resume the larger part of its work in the hinterland city of Kunming in the Province of Yunnan, where it has continued to be in existence up to the present moment. One can now imagine the danger and trouble we experienced in getting through areas of intensive military operations and lines of blockade, on the way from Peiping to Kunming, a distance of more than 2,000 miles by land and sea.

Furthermore, with a great quantity of material on hand, tremendous difficulty was naturally encountered in arranging for transportation, when all means of communication were in a state of disorder.

In spite of the hardships arising from the lack of the necessary equipment, shortage of funds and the constant menace to our personal safety, the work of the Academy is still in progress, to an extent far beyond the most sanguine expectations. Our activities have been vigorously pushed even under the most difficult conditions. Our interest and belief in science do not suffer the slightest diminution. Before going on to the work, completed or being done in our institutes during the last five years, which will amply testify the above statements, a few words on the general situation of the Academy as a whole following a period of internal readjustment to adapt itself to the present environment, may be added here.

The National Academy of Peiping, still with its nine institutes, has now a smaller staff of 120 members. The major portion of our funds comes from the Government and amounts to $620,000 annually *plus* a variable monthly addition used to compensate the ever-rising cost of living under which our colleagues and their families must live. Naturally, we have an exceedingly hard time in managing to stretch this money to cover all of our expenditures, although we are also receiving financial aids from the Sino-American, Sino-British and Sino-French Foundation Funds. Regarding our policy in general, we can say that the greater portion of our research activities tends to be practical and economically important to meet the immediate needs of the nation. Our publications, which in former years amounted to nearly fifty kinds of bulletins, journals, memoirs, books and maps, *plus* 800 papers and reports, are still in progress, but on a very much reduced scale owing to the lack of efficient means of printing.

The following will serve to summarize our research work within the last five years in the different institutes. We are rather encouraged to catch a glimpse of the types of researches performed by ourselves since the Japanese invasion and to give our friends some idea of what the scientific workers of China are doing while the nation is being overrun by a catastrophic war.

### 1. Institute of Physics

To comply with our general policy, the Institute of Physics whose studies were chiefly in photography, spectroscopy, piezoelectricity and geophysics, has recently more and more inclined to attack practical problems that confront us in industry and national defence.

With its spectroscopic equipment, a laboratory of spectrum analysis has been immediately set up to meet the need of the just-beginning metallurgical industry in this country.

In the course of the war, numerous radio stations both fixed and movable have been established, but almost all of them are of quite small power. The wave interference between these stations would be troublesome, if they were not crystal-controlled. The Institute has stabilised more than one thousand transmitters with its quartz oscillators made in our laboratories and thereby it has certainly rendered a service to radio communication in China to-day.

Besides the work mentioned above, the Institute has confined its efforts mainly to the development of applied optics and geophysical prospecting.

When we were computing optical systems and designing optical instruments at Peiping, we keenly felt the need of optical instruments both in times of peace and of war. It was, therefore, decided to devote some of our members to the problems of applied optics and to set up a small optical shop in Kunming. For this purpose optical machinery had to be built, testing instruments to be designed, and craftsmen to be trained. After three years' painstaking work, we have arrived at a state of being able to produce most of the optical parts in good quality.

Optical parts like achromats, prisms and flats have been abundantly supplied to various institutions for educational and research purposes. Microscopes for the general usage of university students are being made in this shop according to the instructions of the Ministry of Education, and two hundreds of them are nearly completed.

In geophysics the establishment of a gravity map of China and the precise determination of longitudes and latitudes had been our two main undertakings. Since our removal to Kunming, although we continued the gravity determinations throughout the province of Yunnan to the borders

of Burma and Indo-China and redetermined the longitude and latitude of Kunming, the attention of our geophysicists, however, has been directed to our mineral resources, and their methods have been immediately put into application.

Our work in geophysical prospecting was mainly the study of metallic ore deposits. Up to the present, five different mining districts have been thoroughly examined by our geophysical field parties employing chiefly magnetic and electrical apparatus. The N.R.C. (National Resources Commission) I-Men Iron Mine was the first one surveyed, and this took us six months of field and office work. Then came the An-Ning Iron Mine, the Kuchiu tin mine, the Lu-Tien lead-silver mine, and lastly the Chaotung lignite field. All of these were successively subjected to geophysical investigation.

These studies have been carried out upon the request of the respective mining organizations whose interest and enthusiasm in geophysical methods are very encouraging. The results have not only greatly altered the concepts of the geologists and mining engineers as to the extent and economic value of these deposits, but also numerous facts and experiences arising from them have opened the door to improvements in the methods of geophysical prospecting. These results are thus also of academic interest.

Co-operating with the Geological Survey of China, we have organized a committee on geophysical work, which publishes all the contributions from the geophysical investigators of the country.

### 2. Institute of Radium

The Institute of Radium consists of three laboratories, that of chemistry, radioactivity and X-rays. In the two first a great number of Chinese minerals were examined chemically and radio-actively. Protactinium was much studied and its branching ratio redetermined with counters. A detailed study of the absorption coefficients of $\beta$-rays especially from $UX_2$ and RaE revealed the important fact that they have neither a fixed nor a single value, but depend on the thickness of the absorber and the surrounding conditions of the source under measurement.

In our laboratory of X-rays, the work is mainly on crystal analysis. Some improvements on classical methods and techniques have been made. With an induction furnace, some alloys of tungsten and antimony were prepared, and X-ray studies of them are now in progress.

### 3. Institute of Chemistry

Like most of our other institutes, the Institute of Chemistry has been for the past five years, devoting a large portion of its efforts and time to problems of applied chemistry, in addition to pure chemical researches. Upon this Institute, however, the war seems to have exerted a greater pressure, for the simple reason that here we have to import a considerable amount of chemical reagents from abroad and these are consumed at a rate far beyond our power of replacement. Nevertheless, we have been rather successful in dealing with the situation and are able to carry out our various types of work as outlined below.

In the field of applied chemistry our investigations have been following at least four lines: all of these were problems in which the public was calling for immediate solutions. They are (1) Extraction of dyestuffs from local plants and their application to various textiles, (2) Preparation and manufacturing on a small scale of medicines, utilizing local raw materials, (3) Recovery of used engine oils, replacement of diesel oil by vegetable oil, and preparation of a gasoline substitute from molasses asd sawdust, (4) Miscellaneous experiments such as the analysis of water samples taken from various places in the vicinity of Kunming, the extraction of potash from different kinds of ashes, etc.

In view of the drastic shortage of gasoline, a mobile alcohol plant was brought into operation. Despite its simple design, it steadily produces 200 gallons of 95 per cent. alcohol per day. In co-operation with a soap factory, complete installation of a vacuum evaporating plant has been set up to produce glycerine from the wastes of soap-making.

Concerning pure chemical researches, our attention has been mainly centred on problems of organic chemistry. Topics under investigation, within the period of five years, have been (1) Syntheses of organic compounds related to vitamin K, (2) Molecular rearrangements of organic compounds, (3) Synthesis of rotenone derivatives,

4. INSTITUTE OF MATERIA MEDICA

Research work in this Institute has been concentrated on investigations of Chinese drugs, such as Chinese ephedra, Mahuang, Chinease corrydalis, Pei-Mu, Hsi-Hsin, Mu-Fang-Chi, Shih-Chan-Chu, Yang-Chin-Hua, Kou-Wén, Ta-Ch'a-Yeh, etc. The active principles have been isolated, and their constituent properties as well as the pharmacological actions have been studied. Besides, the Institute also prepares some materials such as ephedrine, vitamin $B_1$, etc., on the commercial scale for clinical use.

5. INSTITUTE OF PHYSIOLOGY

Researches of this Institute were heretofore confined to pure studies in experimental biology and physiology proper, while special emphasis was also laid on the physiological effects of various Chinese drugs. However, within the last five years, in addition to pure academic work, subjects capable of application in daily life have likewise been successfully investigated. In this connection investigations in the nutrition values of the food-stuffs used by the southwestern inhabitants, experiments on the treatment of Chicken's Cholera by sulfanilamide, as also of typhus by some Chinese medicine from the Pentsao, are of significance.

Problems of local importance are now under investigation, namely, studies on the types of Chinese drugs produced in Yunnan and on the basal metabolism of the Yunnanese people.

6. INSTITUTE OF ZOOLOGY

Researches conducted in this Institute were formerly restricted to the study of seashore animals of China. However, since the removal of the Institute from Peiping to this inland city of Kunming, this same sort of work has had to be directed to the limnological fauna of Yunnan. Thus the fauna of the Kunming lake, of the Erh Hai, the Yang-Tsung-Hai and the Fu-Sian Lake naturally have become our most easily attainable material to be worked on.

To intensify such investigations, an experimental station for lacustral biological studies was started in 1939, under the joint auspices of the Institute and the Commissariat of Reconstruction of Yunnan. Such a station is the first of its kind in China and, in spite of its very brief history, it has been able to make systematic studies of the principal fresh-water fauna of Yunnan, particularly the fishes of these inland lakes, their diseases and enemies, together with the chemical and physical properties of the lake waters. Besides aquatic animals, terrestrial animals like Reptilia and the spiders of Yunnan have also been collected and worked on.

7. INSTITUTE OF BOTANY

Instead of going on with the studies on the plant-life of north, northeastern and northwestern China and its taxonomy, the Institute of Botany began, right after its removal to the interior, to do researches on problems of economic botany. Investigations in topics of agriculture and forestry had already been in progress for several years: topics such as, the distribution of forests, classification and disease of farming plants, and particularly experiments on cultivating drug plants, etc.

Under the joint sponsorship of the Institute and the National Northwestern Agricultural College, a special botanic survey was planned and organized with the aim to do researches on the plant-life of China's northwest, as also on their economic values. In 1940, a botanical garden was brought to completion, inside which our experiments have been performed. Botanical parties have been despatched to the various centres of botanic interest throughout the northwest, particularly, the surroundings of our great western mountain ranges. The material brought back has been abundant and valuable. The entire collection of plant specimens belonging to the Institute now numbers more than 60,000.

8. INSTITUTE OF GEOLOGY

For over ten years our geological work has been going on under a co-operative scheme with the Geological Survey of China. Contributions to the science itself and to the geological work of this country have been countless and prominent, the most outstanding one being the discovery and identification of the fossil remains of the well-known *Sinanthropus Pekinensis* (the Peking Man) with its contemporary vertebrates excavated from the limestone caves at Chou-Kou-Tien near Peiping.

Since 1937, extensive field and laboratory studies have been in progress without any loss of their vigour on account of the war. Detailed mapping of mineral deposits occupies at least for the time being, the

major portion of our time spent in geological work, although stress is equally laid on paleontological studies and studies in other branches of the science, *e.g.*, the excavation and investigation of a complete fossil dinosaurs skeleton (*Lufengosaurus Hucenci* Young) from Lufeng Hsien, Yunnan.

As to our work in mineral deposits, *i.e.*, in economic geology, it can be possibly said that hardly any of the important discoveries and investigations made during the last five years in our western provinces have been carried out without the participation of our colleagues.

With a large accumulation of dependable geographical material on hand, the Institute has also revised completely the map of China for general use, and thousands of the new map are now in circulation among the public.

### 9. Institute of Historical Studies and Archæology

In recent years the work of the Institute of Historical Studies and Archæology consists of mainly three items, the studies of literary materials in ancient Chinese history; the classification of archæological materials excavated at Pao-Ki-Hsien, Shensi, several years ago, and the collection of historical materials dealing with the inhabitants in the border zones of China.

In 1933, upon the request of the Shensi Provincial Government, there was appointed a committee which in 1934 started an excavation at Tow-Ki-Tai, a ruined site of Pao-Ki-Hsien in Shensi Province, and by 1937 materials of historical significance obtained were the remains of many human dwelling places in the Stone Age, also relics of ancient city walls and of more than one hundred tombs belonging to various ancient periods. With regard to these materials the first of a proposed series of publications, "Studies of Li-Tripods Excavated at Tow-Ki-Tai" by Mr. Su Ping-Ki, has just gone to press; while the report of the excavation is now under compilation.

Regarding the studies of literary materials in ancient Chinese history several important works have been completed within the last three years. They are (1) "The Legendary Period in Chinese Ancient History", a book of seven chapters (in press) by Mr. Hsu Ping-Tchang, being the investigation based upon ancient legends of the Chinese history from Huang-Ti to the Middle Shang Dynasty; (2) "Tsun-Ko-Tsin-Sze-Hwei Tien", by Mr. Hsu Tao-Ling (the name index for the holders of the degree "Tsin-Sze" during the various Chinese dynasties), being a compilation of the historical materials for the last one thousand years.

Papers in relation to all other investigations can be found in our publication "Collected Papers of Historical Studies".

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PROFESSOR ALEXANDER SILVERMAN, of the University of Pittsburgh, stated in an address at the Franklin Institute, Philadelphia, on December 16 that glass is proving one of the most versatile of all war materials. It has taken over jobs formerly monopolized by such diverse materials as steel, silk and cork. It functions very much like steel in bullet-proof windshields and turrets on airplanes; glass sutures are replacing silk and gut in certain surgical uses; and a new material, bubble-filled masses of glass foam, has replaced cork in much new heat insulation. This glass foam promises to take up cork's job in life preservers also, for it is practically as light as cork and even more resistant to waterlogging. Unlike air-inflated rubber floats, it is indifferent to puncture; if a bullet passes through it, only the cells in the immediate path are destroyed, and the block floats serenely on. In addition to these more or less novel uses, glass serves the war effort in a hundred of its long-established and more conventional forms, all the way from medicine bottles and factory windows to accurately ground lenses for telescopes, range-finders and periscopes and carefully coloured photographic filters.

(*Science-Supplement*, Dec. 25, 1942.)

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## A NOTE ON THE PROBLEM OF *k* SAMPLES

A familiar problem in analytic statistics is to test the hypothesis whether $k$ samples of sizes $n_1, n_2, \cdots, n_k$ have been drawn at random from the same unknown Normal Universe. In general, the $k$ samples could have come from $k$ different Normal Universes with means $\mu_1, \mu_2, \cdots, \mu_k$ and standard deviations $\sigma_1, \sigma_2, \cdots, \sigma_k$. The most common hypothesis tested is whether, given that $\sigma_1 = \sigma_2 = \cdots = \sigma_k = \sigma$, we can infer that $\mu_1 = \mu_2 = \cdots = \mu_k = \mu$, where $\sigma$ and $\mu$ are unknown. The 'statistic' which has been considered appropriate for this problem is Fisher's Ratio of Variances, say $V_b/V_w$ where

$$V_b = \sum_1^k n_i (\bar{x}_i - \bar{x})^2 / (k-1);$$

$$V_w = \sum_{i:1}^{k} \sum_{j:1}^{n_i} (x_{ij} - \bar{x}_i)^2 / (N-k);$$

$$N = \sum_1^k (n_i) \text{ and } \bar{x} = \sum_1^k (n_i \bar{x}_i) / N.$$

When there are only two samples ($k = 2$) we have

$$V_b / V_w = (\bar{x}_1 - \bar{x}_2)^2 / V_w \left(\frac{1}{n_1} + \frac{1}{n_2}\right)$$

which is distributed like "Student's" $t^2$ with $n_1 + n_2 - 2$ degrees of freedom. Fisher has also shown that when $k > 2$, we may compare the differences between any two sample means, by means of the same $t$-test, calculating $V_w$ from within all the $k$ samples, with $N-k$ degrees of freedom. Thus

$$t^2_{ij} = (\bar{x}_i - \bar{x}_j)^2 / V_w \left(\frac{1}{n_i} + \frac{1}{n_j}\right).$$

The total number of such tests of pair comparisons is $k(k-1)/2$. Thus the single hypothesis $\mu_1 = \mu_2 = \cdots \mu_k$ is being broken up into $k(k-1)/2$ separate tests involving the hypothesis $\mu_i = \mu_j$ for the particular pair of $i$th and $j$th samples.

The following identity is easy to prove

$$\Sigma n_i (\bar{x}_i - x)^2 \equiv \Sigma\Sigma n_i n_j (\bar{x}_i - \bar{x}_j)^2 / N.$$

Therefore

$$V_b/V_w = \Sigma\Sigma n_i n_j (\bar{x}_i - \bar{x}_j)^2 / N(k-1) V_w$$
$$= \Sigma\Sigma (n_i + n_j) t_{ij}^2 / \Sigma\Sigma n_i + n_j).$$

The ratio of variances is therefore only a weighted mean of the $k(k-1)/2$ different values of $t^2$. This result brings out clearly the connection between the two tests of significance.

It may be recalled that a paper by P. V. Krishna Iyer[1] and also certain notes he[2] and the author[3,4] published in this journal some

time ago dealt with the same problem of $k$ samples. Mr. Krishna Iyer took the unweighted mean of all the values of $t^2$ and finding it different from the ratio of variances felt that the former would be the proper criterion for discriminating between the sample means. The form he obtained for the distribution of the unweighted mean of all the values of $t^2$ was found to be erroneous. In fact the true distribution does not come out in a suitable form for exact tests of significance. The relationship between the ratio of variances and the weighted mean of the different values of $t^2$, established above would indicate that there is no point in trying to develop a test based on the unweighted mean.

Statistical Laboratory, K. R. NAIR.
Presidency College,
Calcutta,
*March* 10, 1943.

1. P. V. Krishna Iyer, *Proc. Ind. Acad. Sci.*, 1937, **5**, 528. 2. —, *Curr. Sci.*, 1938, **6**, 392. 3. K. R. Nair, *Ibid.*, 1937, **6**, 290. 4. —, *Ibid.*, 1938, **7**, 21.

## AN EXTENSION OF THE NEWTONIAN RELATION

$$\sum_{r=0}^{w-1} (-)^r a_r s_{w-r} + (-)^w w a_w = 0^*$$

THE relations given below may be considered as extensions of the Newtonian relation mentioned above :—

$$G(pq) = \sum_{m=1}^{p-1}\sum_{m=1}^{q-1} (-)^{s+m+2} a_{s+m} G(p-m, q-s) + q \sum_{m=1}^{p-1} (-)^{q+m+2} a_{q+m} G(p-m) + p \sum_{s=1}^{q-1} (-)^{p+s+2} a_{p+s} G(q-s) + \overline{p+q}\,(-)^{p+q+2} a_{p+q}.$$

$$G(p\,q\,r) = \sum_{t=1}^{p-1}\sum_{m=1}^{q-1}\sum_{s=1}^{r-1} (-)^{t+m+s+3} a_{t+m+s}. G(p-t, q-m, r-s) + r \sum_{t=1}^{p-1}\sum_{m=1}^{q-1} (-)^{r+m+t+3} a_{t+m+r}. G(p-t, q-m) + q \sum_{t=1}^{p-1}\sum_{s=1}^{r-1} (-)^{t+q+s+3} a_{t+q+s}. G(p-t, r-s) + p \sum_{m=1}^{q-1}\sum_{s=1}^{r-1} (-)^{p+m+s+3} a_{p+m+s}. G(q-m, r-s) + \overline{p+q} \sum_{s=1}^{r-1} (-)^{p+q+s+1} a_{p+q+s} G(r-s) + \overline{q+r} \sum_{t=1}^{p-1} (-)^{t+q+r+3} a_{t+q+r} G(p-t) + \overline{p+r} \sum_{m=1}^{q-1} (-)^{p+m+r+3} a_{p+m+r} G(q-m) + (-)^{p+q+r+3}\, 2!\, \overline{p+q+r}\, a_{p+q+r}.$$

It may be mentioned that when $p-t = q-m = r-s$, the coefficient of $a_{t+m+s}$ will be $(-)^{t+m+s+3}\,3!$, in place of $(-)^{t+m+s+3}$. Similarly when any two of the terms $p-t$, $q-m$ and $r-s$ are equal, the usual coefficient given above will have to be multiplied by 2!

Similar relation can be given for $G(p, p_2 \ldots p_s)$. For economy in space, the coefficient of a typical term alone is given.

$(\alpha-1)!\ \overline{p_k+p_l+p_m\cdots}$ $\alpha$ terms $\Sigma\Sigma \ldots$. $s-\alpha$ times $(-)^{p_k+p_l+p_m\cdots+\Sigma r_i+s}\, a_{p_k+p_l+p_m+\cdots\Sigma r_i}$.

$G(p_1-r_1, p_2-r_2, \ldots p_k-r_{k-1}, p_{k+1}-r_{k+1}, \ldots p_{l-1}-r_{l-1}, p_{l+1}-r_{l+1}, \ldots)$. As mentioned before, the coefficient will have to be multiplied by $n_1'$, $n_2'$, etc., if $n_1'$, $n_2'$, etc., terms of $p_1-r_1$, $p_2-r_2$, $\ldots p_s-r_s$ happen to be equal.

The importance of these relations lies in the fact that they show the structure of the methods of evaluations of the Bipartitional Functions $G\,a\,(P, Q)$ and $G\,h\,(P, Q)$ by distributions in *plano* dealt with by Dr. Sukhatme. It is not possible in the short compass of this note to bring out these relations. It is hoped to do this in detail later on.

Imperial Agricultural Research Institute, P. V. KRISHNA IYER.
New Delhi,
*March* 15, 1943.

* The notations used in this note are the same as those of Macmahon in his book *Combinatory Analysis* and Sukhatme in his paper entitled "On Bipartitional Functions," *Phil. Trans. Roy. Soc.*, London, 1938, **237**, 375-409.

## NEW FORMULÆ FOR THE DETERMINATION OF MAGNETIC QUANTITIES H, *l*, M AND *m*

FROM the equations $T = 2\pi\sqrt{I/MH}$ and $H \tan\theta = 2Md/(d^2-1^2)^2$, we may obtain from two positions of the deflection magnetometer,

$$H = \frac{\pi\sqrt{8l}}{T} \cdot \frac{\sqrt{d_1/\tan\theta_1} - \sqrt{d_2/\tan\theta_2}}{d_1^2 - d_2^2}.$$

This equation gives better results for H than the equations given by Worsnop and Flint[1] and by Hutchinson.[2] The value of $l$ (half the magnetic length) is eliminated in the above equation and hence no error arises due to its uncertainty. Attention may be drawn to this correct method of calculating H, since it is not usually given in College text-books.

Gordon College,
Rawalpindi, Punjab, V. R. SINGAL.
*February* 26, 1943.

1. *Advanced Practical Physics*, 1927, p. 441. 2. *Advanced Text-Book of Electricity and Magnetism*, 1935, p. 122.

## SOME NOTES ON THE POSSIBLE REPLACEMENT OF TEETH IN *GAVIALIS GANGETICUS*

WHERE there is a continuous succession of tooth formation in a jaw, the new teeth erupting in close proximity to its predecessors, as in some species of fish, the succession has sometimes been termed "endless", but it is doubtful whether there is the constant loss and replacement which is commonly supposed to occur.

Revolving of the tooth-bearing area is out of the question at any rate in crocodiles where, according to Richard Lydekker (1896), the teeth are confined to the margin of the jaw, replacement occurring rather at the base of a shed tooth and in the same position as that of the previous tooth.

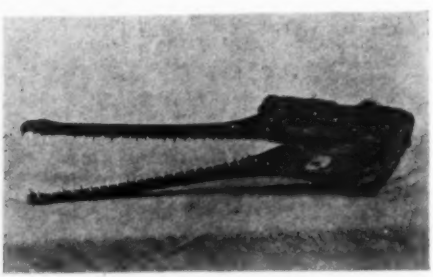
In *Gavialis gangeticus* the almost uniform spacing of the erupted teeth and the almost uniform size of many in a mature specimen shot by S. U. Nasmith in the Ganges does not support the belief that the teeth are at all commonly shed in this fish-eating species.

Although teeth may be missing or worn in old African crocodiles it is usual for the size of the teeth to correspond with the age of the individual which points to the conclusion that some at any rate are the original teeth and that only a few teeth have been shed and replaced during life.

There has been a tendency to apply human experience and what is known to occur in species with deciduous and permanent sets of teeth to all reptiles and it is even stated that the reserve teeth in a crocodile's jaw steadily push out the functional teeth, though dissection shows them independent in a hollow.

Although a new sharp tooth is usually visible at the place vacated by a shed tooth of a crocodile the phenomenon approaches that seen in the Mussel Crusher where some time elapses after a tooth is lost before the succeeding one appears, unlike the mammalian deciduous teeth whose shedding is hastened by osteoclastic action.

A successional tooth can be seen below the apex of many of the erupted teeth in a radiograph taken for me by Dr. Gordon Stewart of Durban but dissection of the *Gavialis* jaw would be necessary to determine how many exist below the twenty-nine teeth of the upper and the twenty-five teeth of the lower jaw.



Head of a twelve-to-thirteen feet specimen of *Gavialis gangeticus* shot by S. U. Nasmith, average length of exposed portion of tooth being approximately half an inch.

Experimental proof would be cruel and misleading but I have seen no sign of the apparently vestigial remains of teeth in crocodiles which I have sometimes noted in the hindermost rows of teeth in some sharks and fishes.

There can be no question that all crocodiles die with many of their reserve teeth unerupted and that, although these buried teeth serve for possible replacement when a functional tooth is lost, the production of teeth is excessive for their present needs.

West Street,
Durban, S. Africa, F. GORDON CAWSTON.
*February* 2, 1943.

1. Cawston, F. Gordon, "Some Notes on the Opposing Surfaces of Teeth," *S. Afr. Dent. Jour.*, **1942, 41,** 408–10, No. 12. 2. —, "A Consideration of the successional theory of teeth," *Curr. Sci.*, **1942, 11,** No. 8. 3. Ditmars, Raymond, L., "Reptiles of the World," p. 64. 4. Lydekker, Richard, "Reptiles," *Roy. Nat. Hist.*, **1896, 5.**

## PIGEONITE IN THE "ABNORMAL" DOLERITE DYKES OF CHARNOCKITIC AREAS IN MYSORE

CERTAIN "abnormal" dolerite dykes from the Biligirirangan Hills have been described by Mr. B. Rama Rao, Director of Geology, Mysore Geological Department. He describes the pyroxenes of these dykes as "pink to purplish, schillerized augite", elsewhere as "purplish to pinkish titanaugite."[1]

Dykes of a similar type have been noticed near Halagur and Dodkanya, two other Charnockitic areas in Mysore. The dykes traverse the general foliation of the gneisses with a rough east-westerly trend. Microsections of specimens of the dyke show plagioclase laths and pyroxene plates disposed in a sub-ophitic texture; in other specimens the pyroxenes cluster in glomeroporphyritic groups with an occasional felspar lath entangled between them, which, in ordinary light, imparts to the rock on ophitic texture; the interspaces between the glomeroporphyritic groups are intergranular with felspar laths; at other times, the interspaces have intersertal chloritic or amphibolic material between the felspars, imparting to the whole rock the "ophimottling" or "poikilophitic" texture.

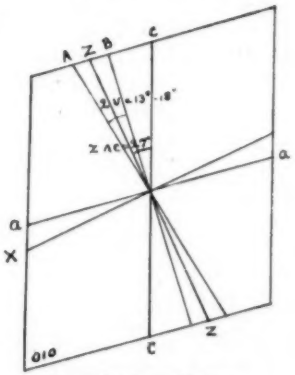
The felspars are dusted with dark dotted inclusions mostly with a clear outer rim; they are twinned on the Albite Law, the most common type being oligoclase, and the most basic type being andesine; there are occasional crystals of microline, and of orthoclase twinned on the Baveno Law; some well-zoned crystals are also present.

The pyroxenes are purplish, showing characteristic pyroxene cleavages, most of them

have kelyphytic borders, but clearer interiors. The kelyphytic borders show a brownish rim which passes outside into a greenish border, that crystallizes into an amphibole of the sodic type (with the tinge of lavender blue parallel to the Z axis) or at other times, into the brownish blue amphibole of the charnockitic type. The blue tufts in the reaction rims pass sometimes into scales of reddish brown biotite, when appear concomitantly, in the felspars, epidote and sillimanite needles. The interstitial substance bordering the sodic blue reactions are clear albite; vermicular intergrowths between albite and plagioclase (perthite), simulating micrographic texture, and intergrowths between pyroxene and felspar are often seen. The blebs of clear albite suggest sodic infusions.

The pyroxene of the dyke is a Pigeonite[2]. It shows a small optic axial angle varying from almost uniaxial to $2V = 13°$ and 18°. Optic sign is +ve. Contact twins on (100) are very common, strain shadows, splitting isogyres, in successive lamellæ, are observed in a (100) section.

$Z \wedge c = 27°$ in the obtuse $\angle\beta$. Positive elongation. $BX_{ac}$ nearly $\perp r$ to c(001). XZ is || to 010, and bisects the acute prismatic angle. $(\gamma - \alpha) = \cdot 020$. In pleochroic varieties X = pink, Y = brownish pink, Z = pale green. The parallelism of the optic axial plane to (010) points to the Mysore Pigeonite as a calcic variety.[2]




Pigeonite from Mysore

$2V = 13° - 18°$, + ve.

$N_g - N_p = \cdot 020$

$Z \wedge C = 27°$, XZ || 010

Positive elongation

X = Pink.

Y = Brownish pink.

Z = Pale green.

Pigeonite from the granulites of the Charnockite series has been described by Dr. Groves.[3] He notes the predominance of the clinoenstatite-clinohypersthene molecule in the Pigeonites of Uganda and assigns them to the diopside-hedenbergite series. Similar hypersthenes in the Mysore Rocks of Charnockitic affinities are under investigation. The pigeonite, however, referred to in this note, occurring in the "abnormal" *dolerite* dykes (showing poikilophytic texture), is of the enstatite-diopside series. Computed from Winchell's variation diagrams, this pigeonite has a composition 3 Ca Mg $Si_2O_6$. 2 Mg Mg $Si_2O_6$. Since the presence of the ophitic texture and microperthitic texture point towards eutectic proportions, a volumetric estimate was made of the proportions of Pigeonite to Plagioclase present in the rock, yielding the ratio 60 : 40.

Dept. of Geology,
Central College,
University of Mysore, P. R. J. NAIDU.
Bangalore,
*March* 19, 1943.

1. *Records, Mysore Geological Department*, 1940, **39**, 51. 2. A. N. Winchell, *Text-Book of Optical Mineralogy*, 1939, **2**, 222. 3. Dr. A. W. Groves, *Q.J.G.S.*, **91** 150.

## PROTEINS AND BLOOD FORMATION

THE customary methods of estimating the nutritional values of proteins depend upon comparing their relative efficiencies in the maintenance of nitrogen equilibrium. This is unavoidable in the present state of our ignorance concerning the specific functions in metabolism of individual amino-acids. One of the most important functions of nitrogenous food in the growing as well as in the adult animal must be the regeneration of hæmoglobin. The red blood cells undergo continuous destruction in the body, the hæmoglobin being first broken down into protein and prosthetic group and the hematin then converted into bilirubin. If as is usually assumed the average life of an erythrocyte is three weeks about five per cent. of the total hæmoglobin present in the blood must be regenerated every twenty-four hours. Part at least of the nitrogen required for this purpose must be of exogenous origin in view of the known excretion of the bile pigments in the urine and fæces and the fact that hematin administered as such by injection cannot be utilised for hæmoglobin formation.

There are, however, very few investigations on the relative value of proteins with reference to their ability to promote blood formation. Hart[1] *et al.* studied the relation of proteins to hæmoglobin formation using as experimental material rats suffering from severe nutritional anæmia resulting from an exclusive milk diet. This procedure is, however, open to the criticism that this type of anæmia is not the result of protein deprivation but of iron deficiency and the curative effect cannot be ascribed definitely to protein ingested during the period under test. Recently it was shown in this Laboratory (Yeshoda, 1942)[2] that rats made anæmic by means of phenylhydrazine provide convenient objects for the study of the hæmopoietic action of substances. Phenylhydrazine under the conditions employed produces severe anæmia without causing other adverse effects and the animal has its R.B.C. count and hæmoglobin reduced to about half the normal value

TABLE I

| | Gr. 1 Casein | | | Gr. 2 Wheat gluten | | | Gr. 3 Egg albumin | | |
|---|---|---|---|---|---|---|---|---|---|
| | Days | | % increase | Days | | % increase | Days | | % increase |
| | 4 | 12 | | 4 | 12 | | 4 | 12 | |
| R.B.C. in millions per c. mm. | 3·40 | 5·51 | 62·05 | 3·48 | 4·75 | 36·87 | 3·35 | 5·77 | 72·39 |
| | Days | | % increase | Days | | % increase | Days | | % increase |
| | 5 | 13 | | 5 | 13 | | 5 | 13 | |
| Hæmoglobin gm. per 100 c.c. | 9·14 | 13·72 | 50·12 | 9·14 | 12·41 | 35·78 | 9·04 | 14·29 | 58·08 |

| | R.B.C. | Hæmoglobin |
|---|---|---|
| Standard error of difference between Grs. 1 and 2 .. | 3·17 | 2·79 |
| do. do. do. do. Grs. 2 and 3 .. | 2·38 | 1·10 |

within three to five days after the injection of phenylhydrazine.

With this procedure the relative efficiencies in blood regeneration of the three proteins casein, egg albumin and wheat gluten have been studied. As the object of the investigation was the comparison of the nutritional value of animal and vegetable proteins the whole protein of wheat rather than the gliadin and glutenin were made use of. The diets were made up to contain five per cent. by weight of the protein under investigation, the other components being Starch 75 per cent., Butterfat 8 per cent., Sugar 8 per cent., and Salt mixture (Steenbock's 40 with small quantities of copper sulphate added) 4 per cent. Yeast and shark-liver oil were given twice a week to supply the necessary vitamins. Each diet was fed *ad lib* to a group of six young rats with initial weights of about 90 to 95 gm. The animals were made anæmic by injection of phenylhydrazine as described previously and R.B.C. count and hæmoglobin determinations were made once every four days. The average values for each group and the standard error as calculated from the data for individual animals are given in Table I. The figures given are for the first part of the experimental period, for eight days from the onset of severe anæmia (fourth or fifth day after injection of phenylhydrazine).

It will be seen that while casein and egg albumin are equally efficient in blood regeneration wheat gluten is markedly inferior to the two animal proteins and produces a much slower rise in the hæmoglobin and erythrocyte content. It was further found that while normal R.B.C. and hæmoglobin were restored in about fifteen days in the groups on the first two proteins, the animals receiving wheat gluten returned to normal only at the end of twenty-five days. Records of food intake show that the differences were not due to differences in the quantity of protein consumed.

Experiments on other vegetable and animal proteins and on the effect of feeding protein at different levels are in progress.

Our thanks are due to Mr. D. L. Rajalakshman of the Department of Statistics for the statistical analysis of the results.

University Biochemical Laboratory, Madras, *March* 30, 1943. M. DAMODARAN. P. K. VIJAYARAGHAVAN.

1. Hart, Elvehjem, Pearson, *J.B.C.*, 1937, **119**, 749.
2. K. M. Yeshoda, *Curr. Sci.*, 1942, **11**, 360.

## COMBINED DETERMINATION OF THIAMIN AND NICOTINIC ACID IN FOODSTUFFS BY CHEMICAL METHODS

IN recent years numerous chemical methods have been described for the individual estimation of thiamin[1-8] and nicotinic acid[9-13]. All the procedures described for the extraction of nicotinic acid are, however, drastic and give rise to highly coloured solutions especially with materials of plant origin thereby necessitating separate blank estimations in every case. Further, Kodicek[13] and Waisman and Elvehjem[14] obtained higher values for the nicotinic acid content of cereals than could be accounted for by their biological potency.

In the present investigation, a simple procedure was evolved whereby a combined determination of thiamin and nicotinic acid could be made on the same sample. Further, the final solutions obtained with the majority of foodstuffs were practically colourless or contained only a trace of yellow, which was so small that it could not be estimated by an ordinary Klett Colorimeter.

One to ten grammes of the foodstuff was digested at pH 6-7 for 20-24 hours at 37° C. with an enzyme preparation, prepared from pig's intestinal mucosa. The proteins and other interfering substances were removed by precipitation with basic lead acetate at pH 7·0 and the excess of lead was removed as lead sulphate. An aliquot of the solution after lead treatment was used for the estimation of thiamin by the thiochrome method (Narasinga Rao, unpub-

| Foodstuff | Thiamin | | | | Nicotinic Acid | | | |
|---|---|---|---|---|---|---|---|---|
| | Enzymic hydrolysis | | Autolysis with water | | Enzymic hydrolysis | | Autolysis with water | |
| | μg./g. | % recovery | μg./g. | % recovery | μg./g. | % recovery | μg./g. | % recovery |
| *Yeast* | | | | | | | | |
| Brewer's | 97·9 | 92·3 | 96·2 | 96·0 | 436·7 | 95·0 | 436·7 | 95·0 |
| Torula (grown on molasses medium) | 26·0 | 97·8 | 21·0 | 104·0 | 215·93 | 93·0 | — | — |
| *Nuts* | | | | | | | | |
| Groundnut (*Arachis hypogea*) (ether extract) | 16·7 | 99·0 | — | — | — | — | — | — |
| *Animal Tissues* | | | | | | | | |
| Sheep, liver | 5·8 | 86·7 | 5·2 | 88·8 | 168·5 | 100·0 | 168·5 | 100·0 |
| ,, heart | 4·8 | 95·2 | 3·8 | 81·0 | 37·0 | — | 35·1 | — |
| *Cereals* | | | | | | | | |
| White maize (*Zea mays*) | 4·2 | 101·0 | 4·7 | 86·4 | 11·8 | 105·0 | 9·8 | 92·8 |
| Wheat (*Triticum vulgare*) | 3·9 | 89·6 | 3·9 | 89·6 | 23·8 | 96·8 | — | — |
| *Pulses* | | | | | | | | |
| Bengal gram (*Cicer arietinum*) | 4·9 | 87·0 | — | — | 20·0 | 93·3 | — | — |
| Red gram (*Cajanus indicus*) | 3·8 | 102·0 | 3·5 | 96·0 | 23·0 | 86·9 | — | — |

lished results) and another portion was taken for the nicotinic acid test, after being heated in a boiling water-bath for 30-40 minutes to hydrolyse nicotinic amide to nicotinic acid. The latter was brought to pH 7·0, and nicotinic acid was estimated according to Swaminathan's method.[15] The results of tests carried out with various foods are shown in the table.

The figures for percentage recovery given in the table show that enzyme digestion is the best means of liberating and extracting the two vitamins. Further, the method is also effective in reducing the interference by extraneous substances to a minimum. In the case of fresh foods and yeast preparations, dried in the sun, mere autolysis with water at pH 6-7 was found to liberate both thiamin and nicotinic acid from their biological combinations (see table). However, the use of the enzyme preparation is recommended to ensure complete liberation of the vitamins from all types of foods.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor, Kamala Bhagvat.
*March* 8, 1943.

1. Jansen, B. C. P., *Rec. Trav. Chem. Pays Bas.*, **1936, 55,** 1046. 2. Karrer, P., and Kubli, V., *Helv. Chim. Acta*, **1937, 20,** 369. 3. Hennessy, D. J., and Cerecedo, L. R., *J. Amer. Chem. Soc.*, **1939, 61,** 179. 4. Pyke, M., *Soc. Chem. Indus.*, **1939, 58,** 338. 5. Harris, L. J., and Wang, Y. L., *Biochem. J.*, **1941, 35,** 1050. 6. Prebluda, H. J., and McCollum, E. V., *Science*, **1936, 84,** 488. 7. Melnick, D., and Field, H. Jr., *J. Biol. Chem.*, **1939, 127,** 505, 515, 531. 8. Krich, E. R., and Bergeim, O., *Ibid.*, **1942, 143,** 575. 9. Swaminathan, M., *Ind. Jour. Med. Res.*, **1938, 26,** 427. 10. Melnick, D., and Field, H. Jr., *J. Biol. Chem.*, **1940, 134,** 1; **135,** 53. 11. Harris, L. J., and Raymond, *Biochem. J.*, **1939, 33,** 2037. 12. Bandier and Hald, *Ibid.*, **1939, 33,** 264. 13. Kodicek, E., *Ibid.*, **1940, 34,** 712, 720. 14. Waisman, and Elvehjem, C. H., *Ind. Eng. Chem. Anal. Ed.*, **1941, 13,** 221. 15. Swaminathan, *Ind. Jour. Med. Res.*, **1942, 30,** 397.

## TOXICOLOGY OF FOOD COLOURS AND THE NEED FOR THEIR DETAILED PHARMACOLOGICAL EXAMINATION

Various types of colouring matters, from coal-tar products or from vegetable and mineral sources, have been used by manufacturers of food and dairy products for a long time in Europe and America. Addition of a colour or a mixture of colours to render processed food preparations or beverages 'attractive' and sometimes, also to conceal damage, adulteration or inferior quality is a very common procedure in industrial countries, more particularly marked in America during the last two decades. The problem is slowly assuming importance in India in connection with the proposed colouring of 'vegetable ghee' (hydrogenated vegetable fat) to make it look 'distinctive' from cow or buffalo ghee (clarified butter).

Coal-tar dyes being most readily available during the pre-war days at reasonable prices naturally attracted more attention in India, as elsewhere. As ordinarily manufactured for textile or other industrial purposes, dyes often contain impurities (*e.g.*, traces of arsenic from nitric or sulphuric acid almost invariably used in dye manufacture, lead and copper from utensils employed, harmful organic compounds and intermediates produced by side reactions, etc.), some of which are harmless, whereas others are toxic. These impurities may not detract from the value of the dyes for industrial use, but they would be highly objectionable in a substance designed for human consumption. The Food and Drug Administration of the United States Department of Agriculture[1] have, after careful pharmacological and toxicological examination extending for years, adopted a list of *fifteen* oil- or water-soluble dyes of various shades for purposes of certification to the trade as 'harmless' (in certain concentrations) for human consumption. No dyes outside this list are permitted to be employed until the Federal Administration is

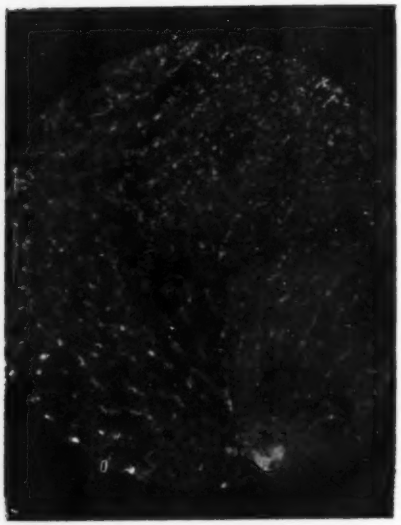


FIG. 1

Liver of a rat, ♂ 210 gm. fed daily with Oil Orange E in arachis oil (approx. 0·4 % dye concentration) well marked degeneration of liver cells (periportal): areas of healthy liver cells round the central vein. The black spots to the left of the vein are eosinophilic infiltration.

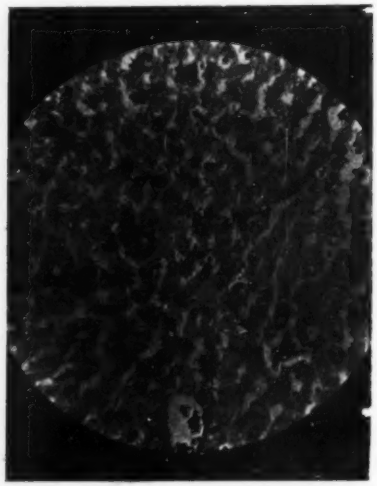


FIG. 2

Liver of a control rat on identical diet minus Oil Orange E. No pathological change is noticed.

satisfied about its purity and absolute safety after a critical and elaborate study of the chemical, pharmacological and toxicological properties of the dye.

During the last two years, the Biochemical Standardisation Laboratory was afforded the opportunity of investigating the pharmacological and toxicological properties of two food colours, one of coal-tar origin (Oil Orange E or Benzene-azo-β-naphthol), and another of vegetable origin, 'Ratanjot' (*Onosma echiodes*). 'Chronic' feeding experiments on white rats extending for 2-4 months were carried out with the dyes in different concentrations (colour intensity readings recorded by means of the Lovibond Tintometer—1938 model), following, in essential, details recommended by Hesse.[2] *Post-mortem* examinations of liver, kidney and heart were made at various stages of the feeding experiments and histopathological changes recorded in permanently mounted paraffin sections.

Addition of 'Oil Orange E' to arachis oil in a concentration adequate to bring the Tintometer reading approximately to 30 Yellow and 30 Red Units (heated to 160-170° C. in presence of moisture as obtainable in ordinary cooking) when fed to white rats in a dosage of about 0·5 c.c. per rat (average weight, 150-200 gm.) every day for 60 days produced loss of weight and a demonstrable pathological change in the liver (see microphotographs). In a less extensive study on rats, Basu[3] has also recorded loss of weight after 8 weeks' continuous feeding, associated with liver and kidney congestion or degeneration. We could not demonstrate any pathological change in the kidney and heart simultaneously with the liver changes.

Organic colouring matters of natural origin such as vegetable colours are usually, relatively speaking, harmless in themselves, or free from harmful impurities. In this class of colouring matters also, it appears desirable to exercise some vigilence, particularly in regard ot the amount of dye to be used daily and the concentration in which it is likely to be ingested along with edible fats. Our experience with 'Ratanjot' as a colouring agent seems to indicate that, in fairly high concentrations and under certain conditions of administration, even a vegetable dye can bring about toxic manifestations as evidenced by pathological changes in the liver and loss of weight of the experimental animals. Whether it is due to any impurity introduced into the dye in the process of extraction or to other factors is yet unknown. Details of the investigations will be published elsewhere.

The need for regular 'certification' of new food colours and the preparation of a list of 'permitted' dyes obtainable from indigenous vegetable and mineral sources (after very thorough and critical pharmacological and toxicological examination) are, therefore, of importance in the interests of consumers of coloured food and dairy products in India. This should be done preferably through a State

Organization, as in America and other European countries.

Biochemical Standardisation
Laboratory (Govt. of India), B. MUKERJI.
Calcutta/Kasauli, N. K. DUTTA.
110, Chittaranjan Avenue, G. C. MOOKERJEE.
Calcutta,
*February* 26, 1943.

1. "Service and Regulatory Announcements. Food and Drug No 3 (First Revision)", *U.S. Dept. of Agriculture Bulletin*, Sept. 1931. 2. Hesse, "Coal-tar colours used in food products", *U.S. Dept. Agri. Chem. Bul.*, 1912, 147. 3. Basu, *Ind. Jour. Pharm.*, 1941, **3**, 193.

## ACTION OF SULPHONAZIDES ON HETEROCYCLIC COMPOUNDS

IN exploring the various possible methods of synthesis of sulphanilamido derivatives of heterocyclic compounds, we came across the reaction discovered by Curtius and Rissom[1] which appeared to give access to compounds otherwise difficult to prepare. This reaction, which can be represented as follows

$$p\text{-R-C}_6\text{H}_4\cdot\text{SO}_2\text{N}_3 + \text{R'H} \rightarrow p\text{-R}\cdot\text{C}_6\text{H}_4\cdot\text{SO}_2\text{NH}\cdot\text{R'} + \text{N}_2$$

where R = H, Me, Cl and NH·Ac

has been extensively studied by Curtius and collaborators.[1] It has been found that in case R'H is benzene, toluene, xylene or naphthalene, the reaction proceeds as represented above, but with aniline, mono-methyl and di-methylaniline it is more complicated yielding other products also, one of them being the sulphonamide ($R.C_6H_4.SO_2NH_2$) arising from the azide. While pyridine yields a (2- or 3-substituted) benzenesulphonamido derivative, with quinoline the only crystalline product isolated is the sulphonamide corresponding to the starting azide.

We have studied, in the first instance, the action of acetsulphanilylazide[2] on thiazole, 2:4-dimethylthiazole, 2-hydroxy-4-methyl thiazole, pyridine and glyoxaline.

Thiazole and 2:4-dimethylthiazole in excess were kept boiling with acetsulphanilylazide till there was no more evolution of nitrogen (12 to 24 hours). In both the cases, the volume of gas collected corresponded roughly to one molecular equivalent. From the reaction products, the only crystalline product that could be isolated in the two cases was p-acetaminobenzenesulphonamide in yields of 25 and 5-10 per cent. respectively. Similarly p-toluenesulphonazide and 2:4-dimethylthiazole furnished only p-toluenesulphonamide in 75 per cent. yield. The action of acetsulphanilylazide on 2-hydroxy-4-methylthiazole led to no tangible product.

Pyridine on boiling with acetsulphanilylazide as described above furnished in poor yields an acetsulphanilamidopyridine, m.p. 280°, which appears to be the 3-substitution product (the m.p.s of the 2-, 3-, and 4-substituted products recorded in literature[3] are 224-227°, 272-275° and 252° respectively).

Glyoxaline in sharp contrast to all compounds studied so far reacted very violently with one molecular equivalent of acetsulphanilylazide at 80 to 110°; one molecular equivalent of nitrogen was evolved in less than a minute and the product obtained was a tar. When, however, the reaction was carried out in small quantities carefully regulated, one molecular equivalent of nitrogen was evolved in about thirty minutes; the product obtained was a mixture from which two crystalline compounds were isolated (with very indefinite m.p.) none of which is identical with p-acetaminobenzenesulphonamide. The structures of these are under investigation.

We are studying the action of the sulphonazides on various other compounds.

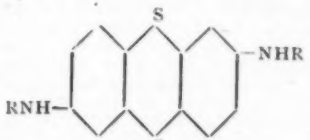
Haffkine Institute,
Parel, Bombay, (MISS) B. S. ALAMELA.
*March* 29, 1943. K. GANAPATHI.

1. Curtius and Rissom, *Z. angew. Chem.*, 1913, **26**, 134; Curtius and Lorenzen, *J. prakt. Chem.*, 1898, (2), **58**, 160; Curtius *et al.*, *Ibid.*, 1930, (2), **125**, 303. 2. Curtius and Stoll., *Ibid.*, 1926, (2), **112**, 117. 3. Crossley, Northey and Hultquist., *J. Amer. Chem. Soc.*, 1940, **62**, 372; Tuda, Iticawa and So, *J. Pharm. Soc., Japan*, 1939, **59**, 213; Roblin and Winneck, *J. Amer. Chem. Soc.*, 1940, **62**, 1999; Winterbottom, R., *Ibid.*, p. 161; Soc. Rhone Poulenc, Fr. 846, 191; *C.A.*, 1941, **35**, 1184.

## SYNTHESIS OF SULPHANILAMIDE DERIVATIVES OF THIANTHRENE

SULPHANILAMIDO compounds possessing heterocyclic rings have come into great prominence as therapeutic agents with the discovery of sulpha-pyridine (B.P. 516288), sulphathiazole, etc. The disulphanilamido derivative of 2:6-diamino-thianthrene has now been prepared.

2:6-Diacetaminothianthrene was prepared according to the method of Ray.[1] The corresponding diamine was obtained from the diacetyl compound by hydrolysis with hydrochloric acid and neutralising with alkali (yellow needles, m.p. 120°C.). p-Acetamino-benzene-sulphochloride reacts with 2:6-diaminothianthrene to yield the diacetyldisulphanilamide of thianthrene (I) which decomposes at 180°.



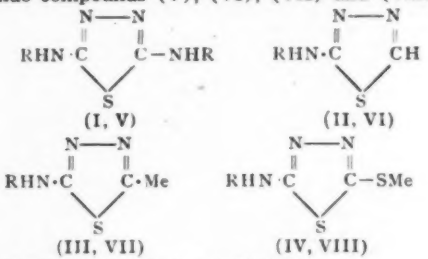

(I, R = $-SO_2\cdot C_6H_4\cdot NHAc$)

Organic Chemistry Section,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore, P. C. GUHA.
*March* 12, 1943. V. M. DOKRAS.

1. *J.C.S.*, 1921, **119**, 1964.

## ON SULPHANILAMIDE DERIVATIVES POSSESSING HETEROCYCLIC RINGS: SULPHANILAMIDOTHIOBIAZOLES

*p*-ACETAMINO-BENZENE-SULPHONYL CHLORIDE reacts with (*i*) 2 : 5-diamino-1 : 3 : 4-thiodiazole, (*ii*) 2-amino-1 : 3 : 4-thiodiazole, (*iii*) 5-methyl-2-amino-thiodiazole and (*iv*) 5-methylthiol-2-amino-1 : 3 : 4-thiodiazole, to yield the corresponding heterocyclic sulphanilamido compounds (I), (II), (III) and (IV) melting respectively at 250-54°, above 300°, 200° (decomp.), and 216-18°. The four acetyl sulphanilamides have been hydrolysed to the corresponding sulphanilamido compounds (V), (VI), (VII) and (VIII),



(I, V) (II, VI) (III, VII) (IV, VIII)

[I-IV, R = $-SO_2 \cdot C_6H_4-NHAc$)
V-VIII, R = $-SO_2 \cdot C_6H_4-NH_2$)]

melting respectively at 223°, 213-14°, 186-87° and 198°. Their toxicity and therapeutic efficiency are under investigation.

Organic Chemistry Section,
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Bangalore, P. C. GUHA.
*March* 12, 1943. D. B. DAS GUPTA.

## CHANGE OF THE GENERIC NAME *PISIONELLA* AIYAR AND ALIKUNHI, 1940, INTO *PISIONIDENS* (*POLYCHAETA*)

SINCE the genus *Pisionella* was erected in 1940[1] for a new Pisionid from the Madras beach, we have found from the *Zoological Records* for 1940, received here in November 1942, that a genus of the same name and family proposed by Hartman[2] for a Peruvian polychæte worm has priority. We are satisfied from a comparison of the descriptions of the worms given by Hartman and ourselves that the Indian worm is entirely different from the Peruvian. We, therefore, propose for our genus the new name *Pisionidens*, which will be the fourth genus of the family Pisionidæ. The Madras Picionid will, therefore, be known as *Pisionidens indica*.

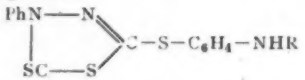
University Zoological Research
Laboratory, Madras, R. GOPALA AIYAR.
*April* 2, 1943. K. H. ALIKUNHI.

1. *Rec. Ind Mus.*, March 1940, **42**, pt. 1, 89-107.
2. *Rept. Allan Hancock Pacific Exped.*, August 1939, **7**, Nos. 1 and 2, 91-93.

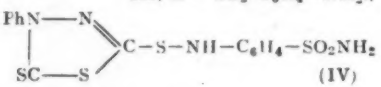
## SYNTHESIS OF SULPHANILAMIDE DERIVATIVES OF MIXED SULPHIDES POSSESSING HETEROCYCLIC RINGS

THE disulphide of phenyldithiobiazolonyl mercaptan gives the aminophenyl sulphide (I) by the action of aniline, and (I) by reacting with *p*-acetaminobenzene sulphochloride, furnishes the sulphanilamido derivative of the mixed sulphide, *viz.*, (II), m.p. 222°; the deacetylated compound (III) melts at 173°. Phenyl dithiobiazolonyl-*o*-amino-tolyl sulphide, however, does not react with the sulphochloride.

Phenyldithiobiazolonyl disulphide reacts with sulphanilamide to yield *p*-sulphonamido phenyl derivative of phenyldithiobiazolone sulphamine (IV), m.p. 155°.



I, R = H; II, R = $SO_2-C_6H_4-NH_2$;
III, R = $SO_2 \cdot C_6H_4-NH_2$);



(IV)

Organic Chemistry Section,
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Bangalore, P. C. GUHA.
*March* 12, 1943. V. M. DOKRAS.

## THE PRESENCE OF A HITHERTO UNDESCRIBED TYPE OF MUSCLE-FIBRES IN THE SEPTA OF *PHERETIMA POSTHUMA* (VAILLANT)

THE occurrence of various kinds of muscle-fibres has already been noted in the septa of Oligochæta by several workers (de Ribacourt, 1901[1]; Kuhlmann, 1908[2]; Pointner, 1911[3]; Nomura, 1913[4], 1915[5]; Bahl, 1919[6]; and Stephenson, 1925[7], 1930[8]), and Bahl (1919) has given a fairly detailed account of the septa in *Pheretima* with particular reference to the sphincters apertures. Our knowledge of the derivation of the muscle-fibres in the septa of the Oligochæta, however, is all but too incomplete, being limited to only a few observations. According to Pointner (1911), some of the septal muscular fibres in *Isochæta* (*Limnodrilus*) *virulenta* can be referred to the longitudinal and circular muscular layers of the parietes, while the others cannot. Bahl (1919) finds that the muscular strands in the anterior five septa (5/6, 6/7, 7/8, 8/9 or 9/10, and 10/11) in *Pheretima posthuma* pass to the body-wall or to other septa in order to support them and keep them in position. Stephenson (1930) remarks that the muscular fibres in the septa of the Oligochæta are mainly derived from the longitudinal muscular layer of the parietes.

While engaged in studying the role of septa in ingestion, peristalsis and egestion in Indian earthworms last year, I noted peculiar muscular fibres in the septa of *Pheretima posthuma* (L. Vaillant), which have apparently escaped

observation so far. These fibres (Fig. 1, *p.e.f.*) are not continuations of the longitudinal muscular fibres of the parietes, as might be expected, but after traversing the septa, pass over into the wall of the intestine and actually form part of the longitudinal muscular layer of that organ. As far as I have been able to ascertain, such a continuation of septal muscle-fibres from the parietal musculature to the enteric musculature has not been recorded hitherto. Their disposition, particularly their

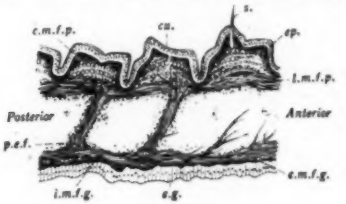


FIG. 1

Longitudinal section through the mid-body of *Pheretima posthuma*, showing the region dorsal to the gut.

*c.m.f.g.*, circular muscle fibres of the gut; *c.m.f.p.*, circular muscle fibres of the parietes; *cu.*, cuticle; *e.g.* epithelium of the gut; *ep.*, epidermis; *l.m.f.g.*, longitudinal muscle fibres of the gut; *l.m.f.p.*, longitudinal muscle fibres of the parietes; *p.e.f.*, parieto-enteric fibres; *s.* seta.

relation to the longitudinal muscular layers of both the body-wall and the gut, indicates a special significance in peristalsis, and one might perhaps justifiably assign to them the role of co-ordinating the muscular contractions of the body-wall with the peristaltic movements of the enteric canal. In view of their peculiar relations, these fibres may be called the *parieto-enteric fibres.*

In this connection one might also mention another relation between the parietal and the enteric longitudinal muscle-fibres which occurs in the anal segment and has not been recorded so far. In this segment (Fig. 2) the longitudinal muscular fibres of the body-wall curve round towards the proctodæum and pass over into the enteric wall as part of its longitudinal layer.

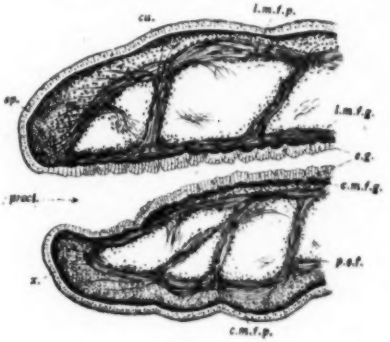


FIG. 2

Longitudinal section of the last three segments of *Pheretima posthuma.*

*proct.*, proctodæum; *x*, the place where the longitudinal muscle fibres of the body-wall curve round to pass on into those of the gut. (Other abbreviations as in Fig. 1.)

My best thanks are due to Mr. Beni Charan Mahendra for his help and guidance in the preparation of this note, as well as to Dr. R. K. Singh, Principal, Balwant Rajput College, for much encouragement.

Dept. of Zoology,
B. R. College,
Agra, RAMESHWAR DAYAL SAKSENA.
*January* 25, 1943.

1. Ribacourt, E. de, *Bull. Sci. France Belg.*, 1901, **35.** 2. Kuhlmann, W., *Dissert. Göttingen*, 1908. 3. Pointner, H., *Z. wiss. Zool.*, 1911, **98.** 4. Nomura, E., *J. Coll. Sci. Tokyo*, 1913, **35.** 5. —, *Ibid.*, 1915, **35.** 6. Bahl, K. N., *Quart. Jour. Micr. Sci.*, 1919, 65. 7. Stephenson, J., *Rec. Ind. Mus.*, 1925, **27.** 8. —, *The Oligochæta*, Oxford, 1930.

## ON THE THALIACEA OF THE MADRAS PLANKTON

THE only collection of Salps made previously from the different regions of the Bay of Bengal is that by the R.I.M.S. *"Investigator"* Expedition. The collections were mostly from the Burma Coast, Mergui Archipelago, Revello Channel and Nankauri Harbour and comprise twelve species of *Salpa* and four species of *Cyclosalpa* (Bomford, Oka and Sewell). The German Deep Sea *"Valdivia"* Expedition, while passing from Sumatra to Colombo, collected six species of *Salpa*, three species of *Cyclosalpa* (Apstein), five species of *Doliolum* and Nurse Forms (Neumann). Herdman has also recorded three species of *Salpa*, *Doliolum* sp. and Nurse Forms in the Ceylon waters.

*Thetys vagina*, *Salpa fusiformis* and *Ritteriella hexagona* were collected from the Madras Coast by the *"Investigator"* Expedition during the months of January and February 1894, from depths ranging from 133 to 250 fathoms. As a result of intensive study of the Plankton collections made in this Laboratory, a large number of forms previously unrecorded from this Coast have been brought to light and it is very likely that these forms will be found to have a wider distribution though it is disconcerting to note that the three species mentioned above do not find a place in this collection. The following forms have been obtained from the Madras Plankton:—

HEMIMYARIA—

1. *Cyclosalpa pinnata* var. *sewelli* Metcalf. (Solitary.)
2. *Cyclosalpa pinnata* var. *polæ* (Sigl). (Solitary and Aggregate.)
3. *Brooksia rostrata* (Traustedt). (Solitary.)
4. *Ritteriella amboinensis* (Apstein). (Solitary.)
5. *Salpa maxima* Forskål. (Aggregate.)
6. *Salpa maxima* var. *tuberculata* Metcalf. (Aggregate.)
7. *Salpa cylindrica* Cuvier. (Solitary and Aggregate.)

8. *Jasis zonaria* (Pallas). (Solitary and Aggregate.)
9. *Thalia democratica* (Forskål). (Solitary and Aggregate.)
10. *Pegea confœderata* (Forskål). (Solitary and Aggregate.)
11. *Traustedtia multitentaculata* (Quoy and Gaimard). (Solitary.)

CYCLOMYARIA—

1. *Doliolum denticulatum* Quoy and Gaimard.
2. *Dolioletta gegenbauri* Uljanin.
3. Two kinds of Nurse Forms.

A detailed account of the forms mentioned above together with information regarding their periodicity, as seen from their occurrence in townet collections made during the last five years, will be given when publication facilities become normal.

Zoological Research Laboratory,
University of Madras, R. VELAPPAN NAIR.
*April* 3, 1943. R. GOPALA AIYAR.

1. Bomford, T. L., *Rec. Ind. Mus.*, Calcutta, 1913, **9.** 2. Oka, A., *Mem. Ind. Mus.*, Calcutta, 1915, **4,** 1. 3. Sewell, R. B. S., *Rec. Ind. Mus.*, Calcutta, 1926, **28.** 4. Apstein, C., *Wiss. Erg. Deutsch. Tiefsee-Exp.*, 1906, **42, 3.** 5. Neumann, G., *Ibid.*, 1906, **12,** 2. 6. Herdman, W. A., *Pearl. Oyster Fish. Rep.*, Ceylon, 1906, **5.**

## EFFECT OF STORAGE TEMPERATURES UPON THE VISCOSITY BEHAVIOUR OF POTATO STARCH

THE viscosity of 1 per cent. potato starch-paste varies from season to season. This is a great handicap in the sizing of fabrics as the amount of size taken up depends upon the viscosity of the size.

In Fig. 1 the viscosity behaviour of a high grade potato starch together with some commercial samples of potato starches is shown.

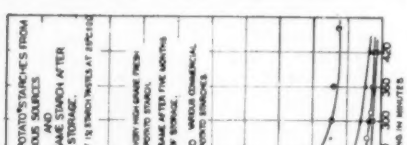

FIG. 1

Curve A was determined in January 1935 while Curve B was obtained for the same starch after five months of storage. The other curves are of several commercial starches obtained from various places during July of 1935.

It will be seen from Curves A and B of Fig. 1 that enormous differences exist in the viscosity behaviour of the same sample of starch during winter and summer. It was thought that the temperatures of storage might have been the cause of this wide variation.

A fresh sample of potato starch was obtained from the Presque Isle Mills of the New England Starch Company through the late Dr. J. R. Katz (in whose laboratory this work was carried out at Cambridge, Mass., U.S.A.) in the first week of July 1935 and its viscosity determined. This sample showed the lowest viscosity that the author has observed in potato starches. On July 11th, 1935, 25-gram samples of this starch were hermetically sealed in Pyrex glass tubes to avoid any differences due to moisture changes during the period of storage. One sample was kept in a refrigerator at 4° C., another in a room where the temperature during day remained around 21° C., and a third at a temperature of 30° C. The tubes were cut open during the last week of September 1935 and the viscosity of 1 per cent. pastes determined in the usual manner.[1] The results are shown graphically in Fig. 2.

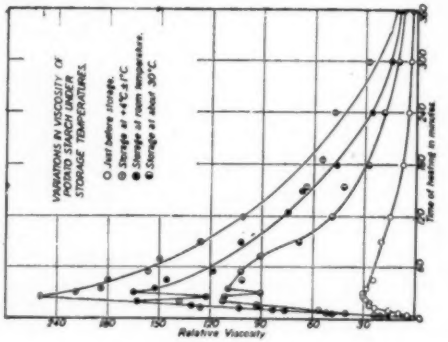

FIG. 2

It will be seen that the temperature of storage has greatly affected the viscosity behaviour of starch. The sample stored at 4° C., records the highest viscosity. The lower the storage temperature, the higher will be the maximum viscosity attained. The results seem to indicate a reversible reaction of the type

High temperature of storage
High viscosity starch ⇌ Low viscosity starch
Low temperature of storage

College of Agriculture,
Poona, MANOHER C. DESAI.
*February* 11, 1943.

1. Katz, J. R., Desai, M. C., and Seiberlich, J., *Trans. Faraday Soc.*, 1938, **34,** 1258.

# REVIEWS

**The Life of Sir J. J. Thomson.** By Lord Rayleigh. (Cambridge University Press, London), 1942. Pp. x + 299. Price 18*sh.*

Sir J. J. Thomson's own *Recollections and Reflections* is already available to those who wish to understand and appreciate J. J. But, there are several facts and incidents which J. J. had skipped over in his account for reasons of modesty. Besides, a clear and coherent account of his life by anyone except himself is most necessary when it is realised that J. J. and his school really laid the foundation of modern physics. The book under review fulfils both these wants. It does not in any way duplicate J. J.'s own account. It is written in a complete, accurate and extremely lucid form. Lord Rayleigh has done a signal service to the scientific world in general and to physicists in particular by writing this excellent and much needed book.

The first chapter gives an account of J. J.'s life till his appointment as Cavendish Professor of Physics at Cambridge. It would have been better if the author had devoted a little more space and given some more details of J. J.'s early life. Chapter II provides factual information of J. J.'s early days at the Cavendish. Chapters III, IV, V, VI and IX give an account of J. J.'s contribution to physics. These chapters are most beautifully written and bring out very clearly the importance and outstanding excellence of the contributions made by J. J. and his school to physics. Few can excel Lord Rayleigh in presenting in a proper perspective the difficulties and the outstanding excellence of these pioneer experiments. These chapters contain plenty of good physics most eminently described and no one interested in physics can afford to miss them.

The rest of the book represents a faithful account of the varied aspects of J. J.'s life and career. The chapters on J. J. as Master of Trinity contain graphic descriptions which can hold the attraction of even the most disinterested reader. Controversial points like J. J.'s correspondence with Sir James Dewar when J. J. was President of the Royal Society and J. J.'s correspondence with the late Lord Rutherford prior to the latter applying for the Cavendish Professorship come up for the most lucid description and bring out clearly J. J.'s wide outlook and broadmindedness. The last chapter on J. J.'s closing years is written in a most touching way and the reader as he goes through it becomes one with J. J.'s admirers and feels fully the respect and regard that all had for J. J.

The book is in itself a most fitting memorial to J. J. This is really no overestimate! The printing and get-up are excellent. The reviewer has absolutely no hesitation in saying that the book will be a valuable addition to any library, public or private.

S. V. CHANDRASEKHAR AIYA.

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**Annual Review of Physiology, Vol. IV, 1942.** Editors J. M. Luck & V. E. Hall. (Americ. Physiological Society and Annual Rev. Inc., California), 1942. Pp. 709. Price $5.0.

Although the war has further limited the possibilities of receiving scientific contributions from a large part of the world, nevertheless a huge material was collected and reviewed in this volume. In 23 chapters 3,925 papers have been critically evaluated and all the important results obtained up to the second half of 1941 have been lucidly arranged. Obviously, it is impossible to reproduce in a few lines the contents of this *Review* which fill 55 pages of a subject index. An excellent staff of collaborators, most of them being leading experts in their own field, not only succeeded in producing a most useful and reliable work for ready reference but also a very readable and stimulating manual, presenting a balanced picture of the progress made in those subjects, which are included in the present volume. In the section on "permeability" *Blinks* reports the revolutionary results, achieved by using artificial radioactive elements as tracers of permeability. *Aebersold* and *J. H. Lawrence* survey "the physiological effects of neutron rays" which would become more effective than X-rays in destroying malignant tissues if boron could be introduced into the growth. The chapter on "physiological aspects of genetics" by *Strandskov* shows the importance of this young science for the understanding of immunology and endocrinology. *Hamilton* and *Willier* treat the influence of hormones and nerve correlation on "developmental physiology". *J. P. Peters* in the section on "water metabolism" deals with the distribution of water in the body, the forces that determine its allocation to various compartments of the system and the interchanges between them and the factors—especially endocrine influences—that control exchanges of water with the environment. Results of experiments on "growth" and differentiation in seed plants and slime molds are reported by *Avery, Jr. Chambers, Shorr* and *Barker* present the recent contributions to our knowledge of environmental and hormonal influences on "energy metabolism", including that of organs and isolated tissues. A short but interesting section on "the physiology of the skin" with special reference to pain and itching by *Baird Jr., Lever* and *Spies* is followed by *Hertzman's* survey of "the peripheral circulation", which contains some important material on the vasomotor system and shock. Very instructive is *Visscher's* article on the "heart", including results of clinical and pharmacological interest. *H. P. Smith's* chapter on "blood" gives a useful review of all aspects of blood coagulation and discusses recent investigations on erythrocyte formation. *Van Liere's* report on the "digestive system" abstracts numerous (200) papers on salivary secretion, gastric and intestinal secretion and absorption, on motility and allied subjects. An important

contribution is *Shannon's* chapter, dealing with the "kidney". He considerably clarifies the position regarding fundamental problems such as discrete renal processes and their interrelation, excretion of water and electrolytes and experimental hypertension. Progress achieved in "electrophysiology" is well brought out by *Gerard*; it becomes clear that electric currents in cells and tissues are involved in the integration of function, metabolism and growth. New results, obtained in neurophysiology, are to be found in the sections on "spinal cord and reflex action" by *Ruch*, "the central nervous system by *Hines* and "the autonomous nervous system" by *Hare* and *Hinsey*, which cover adequately the advances made in these almost unlimited subjects, which include such interesting topics as the extension of synaptic surface on the nerve cell, the status of the ventral horn cell, a new function of the anterior cerebellar lobes and the complex problems of reflex physiology. Among the contributions to the physiology of "sense organs", critically arranged by *Hartline*, should be mentioned that the retinal mechanisms concerned with colour vision have been explored with the aid of a microelectrode, a method which permits discerning clearly the activity of individual retinal ganglions. Out of the "metabolic functions of the endocrine glands" *C. N. H. Long* considers especially those of the anterior pituitary, the adrenal cortex and the pancreas. More than 480 contributions to "the physiology of reproduction" have been reviewed by *Hisaw* and *Astwood;* they give a clear-cut picture of the present-day opinions on the œstrous cycle, metabolism and physiological effects of sex hormones, menstruation, sexual skin of primates, lactation and placental hormones. *C. P. Richter* impresses upon the reader the increasing interest in "physiological psychology", which has led to considerable advances, made in electroencephalography and the treatment of mental disturbances by frontal lobectomy, electrical shock and hormones. Those interested in physiology, applied to modern warfare, will find the article by *Behnke* and *Stephenson* full of interesting informations; they deal, especially, with the effect of low and fluctuating pressure in aviation and high pressure in diving and the submarine service; also problems of health preservation under extreme conditions are treated. The concluding chapter by *M. I. Smith* deals with "the pharmacology of drug addiction", limiting the drugs concerned to morphine and derivatives, alcohol, cocaine, barbiturates, amphetamine, acetanilide and cannabis.

This publication, containing a masterly digested inexhaustible material, pertinent to so many branches of biological and medical science, is a real asset to post-graduate students, teachers and research workers, offering to all of them the most reliable information on the recent position of many physiological and clinical problems. Under the present circumstances, when foreign literature reaches this country extremely delayed, when hardly any one volume of the journals and magazines contains all the issues, due to the hazards of communication, we do not think that the value of this *Annual Review* could be exaggerated or a subsitute for it could be found.

ROBERT HEILIG.

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**Yantrik Shodhachya Navinyakatha.** By K. A. Damle, B.SC. (Published by the author at Damlewada, Shastripol, Baroda), 1940. Pp. 140. 46 Figs. Price Rs. 1-8-0.

This publication is the first of a series entitled 'Vijnanmala' published by the author himself. The book is a narrative about some of the inventions with the results of which we are quite familiar. The book is in Marathi and perhaps it is the first of its kind in the language. It is written from the point of view of the general reader and although it is concerned with what may be described as technical matter, the method of presentation is such that it forms a very interesting reading indeed.

The first chapter deals with the birth and growth of the sewing machine while the third gives the story of the bicycle. It is followed by two other chapters, the first telling us as to how the typewriter came into existence and the way it assumed its present form and the second about the various inventions that have made possible the remarkable development that has taken place in the art and technique of the printing press. After this there is a discussion about the possible advantages and disadvantages of the machine age. Finally, there is the fascinating history of the gramophone.

When the time comes for taking out a second edition of the book—which it is hoped will be soon—the following suggestions may be considered. The order of the chapters may be slightly altered so that chapter two comes first while chapter six goes to the end. A few more diagrams may be added with explanatory notes. At the end of each chapter a sequence of different steps which go to make the particular invention may be given.

There is one more point which deserves mention and that is the satisfactory manner in which the author has rendered into Marathi various technical terms for which there were no ready equivalents. Altogether this book is a praiseworthy attempt on the part of the author and deserves congratulations.

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**Mineralogy, Petrology and Economic Geology—Tables for the Use of Geologists, Prospectors and Mining Engineers.** By N. L. Sharma. (Indian Society of Engineers, Calcutta), 1942. Pp. 22. Price Rs. 3-8-0.

The booklet is divided into three chapters. The first deals with mineralogy, the second with petrology and the third with economic mineralogy. Each chapter consists of a number of tables which are meant as ready reckoners for a geologist, or a student of the subject. Two tables are dedicated to crystallography, six to physical characters of minerals, one for chemical composition, one for blowpipe tests and one for microscopic characters. There are three tables for petrology treating respectively with Igneous, Sedimentary and Metamorphic rocks. The chapter on Economic Geology also comprises of three tables, one

indicating the uses to which various minerals are put, the second giving the classification of deposits and the third showing the distribution of economic minerals in India. Each table is preceded by a small introductory note. The great utility of a booklet of this nature for students of the subject cannot be gainsaid and Mr. Sharma should be complemented on this work.

The value of the booklet would be enhanced by a foreword or an introduction giving the scope and the procedure adopted. The title gives the impression that it is mostly meant for the professionals but at the end of the first page it is stated that it is meant for students. The notes given are too elementary for the understanding of the tables especially in crystallography and optical mineralogy. Both morphological and physical mineralogy (p. 1) may be included under the general term physical characters. The term 'crystalline habit' and 'structure' as defined by the author on pages 3 and 4 are more generally included in one term 'Habit' or 'Form', the term 'structure' usually referring to X-ray structure or space lattice of a mineral. Table 3 should, therefore, be termed 'crystalline form' and Table 4 'Habit' respectively. Excepting for certain metallic minerals, colour is a variable factor in minerals and hence the different types of streaks could also have been included (p. 9). Instead of cataloguing the optical and mechanical parts of a petrological microscope (p. 12) a sketch of the petrological microscope with different parts labelled and an explanatory note on the parts, would have been better. Similarly sketches of the different optical figures would have been more helpful.

In the classification of mineral deposits (p. 20) 1, 2, 4, 5 and 6 are all magmatic deposits. To distinguish them the various stages of magmatic intrusion should be considered, *e.g.*, 1, is magmatic segregation and the rest come in the pegmatitic, pneumatolytic or hydrothermal stages. In giving the distribution tables for economic minerals in India the more important deposits which are being actually worked should be distinguished from less and insignificant deposits.

Other constructive suggestions could be offered, in particular for the section of petrology, and we hope that the author will consider all these when he brings out a second edition of this useful reference book. A stiff cover for the book would be welcome. The author deserves the gratitude of all students of geology for this useful compilation.

B. V. I.

## SUPER-NORMAL FACTORS IN HUMAN PERSONALITY*

DR. ATREYA has departed from the usual routine in choosing a subject for his Presidential Address. The subject chosen, ought to be, rightly, of interest to all psychologists and other students of human nature. He makes a passionate plea for the correct understanding of what are usually known as super-normal phenomena. This, he believes, is necessary if one wants to avoid complete disaster of modern civilization.

He feels it a duty of modern psychologists to interest themselves in the study of super-normal facts of human experience. These super-normal facts are divided into: (1) Miraculous cures and super-normal control over the body, (2) Exteriorization of Motivity and Telekinetic Phenomena, (3) Apparitions, (4) The Aura and the Astral Body, (5) Super-normal Cognition, (6) Crystal-gazing, Automatic Writing and Speech, Dowsing, (7) Genius, Materialization, Ectoplasm, Paraffin Moulds and Fingerprints, (8) Transmediumship, and (9) Reminiscence of Past Life.

All the topics are dealt with in an interesting way. The author has tried to persuade the reader to accept these as facts, by adducing a number of facts as evidences. In most cases these evidences are taken from the writings of other persons interested in the topic. Though, ordinarily such a procedure is exact enough, in matters connected with super-normal phenomena where verifiability is extremely difficult if not rare, to base our conclusions on the assertions of others might be considered risky by the more orthodox sections amongst scientists. There is no doubt that some of the phenomena cited are genuine and serious-minded experimentalists like Rhine, are devoting time and energy for a proper understanding of them.

By far the most important chapter of the Address is the last one where the author speaks of the bearing of the super-normal facts of experience on the theory of human personality. Acceptance of the inevitable fact of Telepathy and a proper understanding of the operative laws—as Worcollier has tried to—will considerably change our conception of human personality and relationship. Mrs. Sidgewick long ago made a similar plea. If one has not been able to achieve much since then, it is not because of lack of interest on the part of psychologists. It is because of the subtle nature of the phenomena themselves and the extreme caution necessary before hazarding laws and rules operative in super-normal phenomena. But the task is urgent and a proper understanding of the phenomena might reveal truths on which depend human destiny.

Though one cannot fully subscribe to the author's views—which he sometimes modestly asserts—yet, Dr. Atreya has laid all the psychologists under a deep debt of gratitude by this well-written, thought-provoking and thorough address, on a subject which less brave souls would have hesitated to speak about.

N. S. N.

* Summary of the Presidential Address of the Section of Psychology and Educational Science, *The Indian Science Congress*, **1943**, delivered by the President Dr. B. L. Atreya, M.A., D.Litt.

# ANNUAL REVIEW OF BIOCHEMISTRY

**Annual Review of Biochemistry, Vol. XI.** Edited by James Murrey Luck and J. H. C. Smith. (Annual Reviews, Inc., Stanford University P.O., California), 1942. Pp. x + 736. Price $5.00.

TWENTY-SIX reviews covering about six hundred and sixty pages comprise the volume. Some of the newer aspects of biochemistry so far not discussed in previous volumes are to be found, *e.g.*, the Chemistry of Visual Substances, Avian Biochemistry, Biochemistry of Teeth and Plant Tissue Cultures. Dubos has reviewed the subject of microbiology from the new standpoint of cell metabolism in relation to the anti-bacterial agents of synthetic, biological and microbial origins.

Special attention may be invited to Gyorgy's review on the Water-Soluble Vitamins to whose number new vitamins are being added year after year. The review commences with a pertinent discussion on the definition of a vitamin, and includes a critical appraisement of microbiological methods in the study and assay of vitamins. Those interested in the assay of Vitamins A and D will find the chapter on Fat-Soluble Vitamins by Morton, interesting and valuable. He invites attention to a new method of assaying D in liver oils; this involves a chromatographic adsorption of non-saponifiable matter from heptane solution on a column of "Hydraffin $K_4$"—an active carbon from Lurgi G.m.b.H. Frankfurt a.M. The chromatogram is developed and eluted with heptane and the vitamin determined spectrographically by means of the ultra-violet maximum at 265 $m\mu$.

Van Veen reviewing the subject of nutrition, has happily recognised the non-applicability of Western standards to nutrition problems arising in the tropics and in the Far East. He adds, "The reason for this is that these regions, which include such an extensive area of the earth's surface, differ considerably in climate, density of population, diet, nature of soil, etc. There are, however, certain circumstances which make it possible to speak about nutrition problems which most tropical countries and countries in the Far East have in common and which—at least in many respects—often differ from those in temperate regions, especially in North America and Europe." If nutrition workers will remember this in future, they will avoid the many pitfalls which their predecessors have encountered.

Mitchell's review on the metabolism of proteins and amino acids is extremely interesting and a valuable contribution. Discussing the theories of protein metabolism, he refers to the brilliant investigation of Schoenheimer and his collaborators, involving the employment of amino acids and other nitrogenous compounds containing strategically placed $N^{15}$ isotope and deuterium. This experimental mode of attack has revealed that urinary creatinine is derived from tissue creatine. Further "the major mechanism for urea formation was proven to be the ornithine-arginine cycle, the conversion of phenyl alanine to tyrosine was found to occur readily in the body even in the presence of an excess of dietary tyrosine, the importance of glutamic and aspartic acids in transamination was established, the conversion of ornithine to proline and glutamic acids was shown to occur, and the anabolic utilisation of unnatural isomers by inversion to the natural form was demonstrated with *d* (+)-Leucine". The reviewer adds, "The most important discovery of the researches of Schoenheimer and his colleagues with labelled amino acids was the revelation of the existence of dynamic equilibrium between the tissues of the body and the surrounding nutrient media that had not previously been suspected".

Other reviews include Biological Oxidations and Reductions by E. G. Bull, X-ray studies of the Structure of Compounds of biochemical interest by M. L. Huggins, Hydrolytic Enzymes —non-proteolytic by D. Glick, the Chemistry of the Acylic Constituents of Natural Fats and Oils by T. P. Hilditch, the Chemistry of Steroids by C. W. Shappe, the Chemistry of the Proteins and Amino Acids by J. T. Edsall, Lignin by Hibbert, the Chemistry and Metabolism of the Compounds of Phosphorus by J. C. Sowden and H. O. L. Fischer, Carbohydrate Metabolism by M. Somogyi, Fat Metabolism by E. Chargaff, the Chemistry of the Harmones by J. J. Pfiffner and O. Kamm, the Clinical Aspects of Calcium and Phosphorus Metabolism by W. E. Cohn, E. T. Colm and J. C. Aub, the Chemistry of Muscle by G. A. Millikan, Animal Pigments by D. L. Drubkin, the Alkaloids by L. C. Craig, Mineral Nutrition of Plants by A. H. K. Petrie and Immunochemistry by J. R. Marrack. The volume is as usual provided with a very helpful author and subject index.

With this volume under review, the Annual Review of Biochemistry enters upon its second decade of distinguished service in promoting the advancement of every phase of Biochemistry. The last decade has been one of the most eventful periods in the history of biochemical research as revealed by a study of the series which has faithfully portrayed the progress year after year.

There is one aspect of service which such reviews can render and that is one which is not generally comprehended and appreciated. We refer to the dynamic part played by the reviews in inspiring new lines of attack, in stimulating original thoughts and in directing the course of research in fruitful channels. It is not easy to assess this role but it may be stated that the Reviews have played a definite part in this.

On the occasion of the commencement of the second decade, it is only appropriate to recall that it was the genius of Dr. Luck that first conceived the idea of these reviews and his robust and wholehearted drive established it as a permanent Institute. Biochemists the world over will join with us in expressing our grateful appreciation of his devoted labours in this direction.

# CENTENARIES

## Wallace, William (1768–1843)

WILLIAM WALLACE, a British mathematician, was born of a leather-manufacturer, 23 September 1768. Having served, as a boy, in a book-bindery and then in a printing office, he learned mathematics and classics by his own industry. In 1794 he became a mathematics teacher in Perth Academy and began contributing to the *Transactions of the Royal Society of Edinburgh*. His work attracted the notice of John Playfair who secured him a teaching post in the Royal Military College in 1803. In 1819 he succeeded to the professorship at Edinburgh.

Wallace was mainly responsible for the erection of the observatory at the Carlaton Hills and of a monument to Napier, the inventor of logarithms. He invented the eidograph and the chorograph.

Wallace died at Edinburgh, 28th April 1843.

## Cartwright, Edmund (1743–1823)

EDMUND CARTWRIGHT, the inventor of the power loom, was born at Marnham, 24 April 1743. He entered Oxford at 14 and was enabled by a special act to take his degree before the prescribed age and was made a Fellow of Magdalen in 1764 and in 1779 he became rector of a provincial town.

In 1784, Cartwright paid a holiday visit to the spinning mills at Cromford. Soon after his return home, he constructed a power loom and took patent in 1785. In 1787, he set up a factory of his own at Doncaster to work with his power loom.

In 1782 Cartwright invented a wool-combing machine. It saved labour so much that some 15,000 wool-combers appealed to the Parliament for protection.

On the petition of fifty prominent Manchester firms, the Parliament granted him a sum of £10,000 in recognition of the services rendered by him to the nation by the invention of the power-loom.

Cartwright died at Hastings, 30 October 1823.

University Library,
Madras, S. R. RANGANATHAN.
*December* 4, 1943.

# SCIENCE NOTES AND NEWS

**Preventive Methods for the Remission of Malaria.**—The discovery that a deficiency in biotin, nature's most powerful vitamin, greatly increases the susceptibility to malaria and that an adequate amount of the vitamin will increase resistance to the infection, was reported this week in *Science*. Experiments on chickens and ducks, which led to the findings, are described by Dr. William Trager of the Princeton Station of the Rockefeller Institute for Medical Research.

The discovery clears up for the first time the long-standing mystery of why some individuals are more susceptible to malaria than others, and marks one of the very few instances in which a specific vitamin has been found to increase resistance to a specific disease—in this case, one that inflicts several hundred million people throughout the world. Thus there is opened for us a new avenue of approach for the prevention of malaria which promises to be of considerable value to our armed forces in lands where malaria is prevalent. Biotin is found in large amounts in egg yolks, liver, milk and, to a lesser degree, in a number of other foods.

Chickens and ducks, made biotin-deficient by being kept on an egg-white diet for two or three weeks, were subsequently inoculated with large doses of malaria parasites. They showed their peak in parasite numbers to be 50 to 100 per cent. higher than those shown by control animals, while among the biotin-deficient animals, the parasite numbers persisted at a high level several days longer and more animals died of malarial infection than among the controls.

"Certainly the results would indicate that biotin which is a substance of known chemical nature helps determine the degree of resistance of the host to an infection with malarial parasites. The results are also of interest since they provide an example, in addition to the very few thus far discovered, of specific relations between nutritional deficiency and susceptibility to an infectious disease."

**A Cure for Many Diseases.**—An article in the current issue of the *Lancet* by Professor and Mrs. Florey of Oxford, describing the first extensive trial of a new drug, Penicillin, may well prove to be a landmark in medical history, writes the medical correspondent of the *News Chronicle*.

Not only is Penicillin many hundred times more potent than the Sulphonamide drugs, like M and B 693, and Sulphathiazole, but it has also cured infections such as meningitis, staphylococcal and septicæmia in which the Sulphonamide drugs had proved useless.

In one remarkable instance an airman, who had such severe blood poisoning from staphylococci that his lungs were full of abscesses, made complete recovery.

A local application of Penicillin to the infected wounds has also proved most effective. The drug is still quite unobtainable by the public. A tedious and lengthy process is necessary to make only very small quantities. It is to be hoped that further researches may result in larger supplies being produced synthetically and that no effort will be spared to make the benefits of this drug available to everyone.

**The Use of Silica Gel as a Substitute for Agar in Culture Media:** by C. G. Anderson and J. C. Macsween.—In view of the importance of the subject-matter, we reproduce below, in full, an extract from the *Journal of Pathology and Bacteriology*, Vol. 54, No. 4, October 1942:—

The use of silica gel to replace agar in media for the isolation of auto-trophic bacteria was introduced by Kuhne (1890) and developed by Winogradsky (1891) and Omelianski (1899). It has occasionally been recommended for more general use, for example, by Munch (1936), Wahl (1938), Clauberg (1941) and Sterges (1942). Usually rather elaborate dialysis procedures have been employed for removing excess of salts and for introducing the nutrient materials. The difficulty of sterilisation has been mentioned frequently. Autoclaving and steaming result in disruption of the gel unless special precautions as to composition, pH and other conditions are taken.

When it became desirable to grow *Bact. dycenteriæ* Shiga on a solid medium for the production of toxin without contamination by agar products the following method was adopted.

Commercial water glass (sodium silicate) is diluted with water to a specific gravity of 1·3. One volume of the solution is mixed with nine volumes of nutrient broth (or other appropriate medium) and 25 ml. of 0·04 per cent. bromothymol blue indicator added per litre. The solution is sterilised by filtration through Ford SB pads in a Seitz filter as soon as possible after mixing. A delay of even an hour or two considerably slows down the filtration, while standing for two to three days results in gel formation. The filtered broth-silicate mixture is filled into sterile containers, using a burette with a hooded jet. The pH of the medium is then adjusted by the addition of 8N or 4N phosphoric acid under sterile conditions. The strong acid is used for large volumes of medium, for example, 100 ml. in a Roux bottle, and 4N acid for small quantities for slopes or pouring plates. Gel formation occurs between pH 5 and 9, but considerably more rapidly on the alkaline side. The optimum appears to be about pH 7·2 (a very pale blue-green colour of the bromothymol blue), but it can be varied to suit the requirements of the organism under investigation. To bring the broth-silicate mixture to pH 7·2 requires a volume of 8N phosphoric acid approximately one-tenth that of the broth. Gel formation at this pH takes about two minutes, allowing ample time for sloping tubes or pouring plates. It is advisable to incubate plates or Roux bottles for 24 hours in an inverted position before use, in order to allow complete extrusion of fluid from the gel by syneresis. If this is not done the inoculum may be washed off or a spreading growth result. The extruded fluid can be removed in a sterile manner if desired, although it is not really necessary. This preliminary incubation also serves as a check on sterility.

The medium has been found to support the growth of the ordinary pathogens and saprophytes as effectively as an agar medium. Morphologically the organisms appear normal. In the case of Shiga's bacillus, toxin is produced, on autolysis, in as good yield as from organisms grown on ordinary media.

**Kerst Induction Electron Accelerator or Betatron.**—One of the major discoveries in the field of X-rays in recent years is the successful development of an induction electron accelerator or betatron. In a paper appearing in *Physical Review*, 1941, **60**, 47, Prof. Donald W. Kerst of the University of Illinois has described the principle and the constructional details of this new physical apparatus. It works on the same principle as the cyclotron. The electron-generator which is a doughnut-shaped glass vessel, is placed between two circular pole pieces of an A.C. electro-magnet. The electron beam emerging from the hot filament is accelerated during repeated revolutions in the magnetic field. At the end of the cycle, the high-speed electrons fall on a target giving rise to X-radiations. The velocity attained by the electrons is said to be the highest ever attained, being only 3/100 per cent. less than that of light. Prof. Kerst's first model had an output of nearly two million volts. In the treatment of malignant growth in human body, these high-voltage X-rays emerging from the electron tube have maximum effect about 1½" below the surface of the body and could, therefore, be used for such treatment without causing injury to the skin. C. S. V.

**Gramicidin.**—Within the last few years a number of bactericidal substances produced by soil bacteria have been investigated. Of these, certain substances, extracted by alcohol from gram-positive organisms, and especially gramicidin isolated by Dubos and his co-workers (Dubos, R. J., and Hotchkiss, R. D., *J. Exp. Med.*, 1941, 73, 629) appear to be the most important. These investigators found that extracts from cultures of certain soil bacteria and from similar organisms present in sewage, manure and cheese, could inhibit the growth of gram-positive organisms. The most important constituent of such cultures, gramicidin, is apparently a substance with remarkable properties. It is a polypeptide soluble in lipoid solvents, but insoluble in water, so that it has to be administered in suspensions. Unlike penicillin and the sulphonamides, its action is bactericidal rather than bacteriostatic. Against

1. Clauberg, K. W., *Zbl. Bakt., Abt. I, Orig.*, 1941, **147**, 75. 2. Kuhne, W., *Z. Biol.*, 1890, **27**, 172. 3. Munch, H., *Arch. Hyg. Bakt.* **117**, 129. 4. Omelianski, V., *Zbl. Bakt., Abt. II*, 1899, **5**, 537. 5. Sterges, A. J., *J. Bact.*, 1942, **42**, 317. 6. Wahl, R., *Compt. rend. Soc. biol.*, 1938, **128**, 854. 7. Winogradsky, S., *Ann. Inst. Pasteur*, 1891, **5**, 92.

certain organisms it produces its effect in quite high dilutions. This is observed when the experiment is carried out *in vitro* and is also seen in the living animal, especially when the organism used for inoculation is the pneumococcus. Unfortunately the toxicity of gramicidin injected into animals is comparatively high, and it is doubtful whether it is suitable for general administration. It may possibly be of value for local application, and good results have been reported in the treatment of mastitis in cows, following the injection into the udder of suspension of gramicidin.

Much further work will be done on chemotherapeutic substances produced by various kinds of bacteria, and it seems quite possible that discoveries of great therapeutic value may ultimately result from these investigations.

(Robson, J. M., *Chem. Products*, 1942, 6, 15.)

**The U.S.S.R. in War-time.**—The broadsheet *Soviet Planning in War-Time*, issued by P.E.P. (Political and Economic Planning) gives a useful objective account of the ways in which the Russian economy has advanced from one mobilised for war in 1941 to a battle economy, and of the general background of this economy. The machinery of Soviet planning functions through three main stages: first, a comprehensive survey of existing resources; secondly, the formulation of a plan, which is simply the laying down of a series of output programmes which must be carefully dovetailed into each other so that they are consistent; and, thirdly, a mechanism for checking their progress and for providing the elasticity necessary for periodic adjustments. This machinery was evolved over a considerable period of time, and the broadsheet gives a brief account of the purposes and achievements of the three Five-Year Plans. It was only during the second Five-Year Plan that the consumption of foodstuffs and living standards generally rose to any appreciable extent, but an important aspect of that period was the development, partly for strategic reasons, of industrial and raw material resources east of the Urals. Both the first and the second Five-Year Plans between them largely achieved their objectives of the creation of modern large-scale industry and a mechanised agriculture as the basis of raising living standards to a higher level and for national self-sufficiency in war-time.

The third Five-Year Plan provided for further increases in the output of industry and agriculture, but its most striking feature was the huge increase in the resources devoted to defence. Moreover, the whole organization of Russian economic life, with its machinery for central planning and its high degree of military preparedness, makes for a greater degree of continuity between peace and war economies than in any other country except Germany. Owing to the absence of excess capacity, the war sector from the outset had to be expanded at the expense of the peace sector of the economy. The producers' goods industries were, so far as possible, adapted to war production and the output of these industries was reduced. Agriculture was seriously affected by labour shortage due to mobilization, which was only in part made up by urban workers and spare-time labour. Excess purchasing power seems to have been skimmed chiefly by increased subscription to State loans. To effect the heavy losses in production resulting from Nazi occupation of European Russia, great efforts, apart from the evacuation of industrial plant and rolling stock, have been made to increase the absolute absorptive capacity of the Ural and Asiatic regions. New sources of raw materials are being exploited, new power stations established, new coal pits sunk, and new oil-wells drilled. New plantations of rubber-bearing plants, of sugar beet, etc., have been developed, and new substitutes and methods are being employed for the manufacture of sugar and soap. In all this, scientific workers have played a great part, as well as in the simplification and rationalization of many technical processes.

—(*Nature*, 1943, 151, 50.)

## MAGNETIC NOTES

Magnetic conditions during March 1943 were almost as in the previous month. There were 8 *quiet* days, 20 days of *slight* disturbance and 3 of *moderate* disturbance as against 12 quiet days, 15 days of slight, 3 of moderate and 1 of great disturbance during the same month last year.

The quietest day during March 1943 was the 15th, while the 29th was the day of largest disturbance.

The individual days were classified as shown below:—

| Quiet Days | Disturbed days | |
|---|---|---|
| | Slight | Moderate |
| 9, 10, 13, 15, 18, 25, 26, 28. | 1, 3-8, 11, 12, 14, 17, 19-24, 27, 30, 31. | 2, 16, 29. |

One moderate storm of short duration with a gradual commencement was recorded in March 1943, while two magnetic storms, one of moderate and one of great intensity were recorded during the same month last year.

The mean character figure for the month of March 1943 was 0·84 as against 0·74 for March 1942.

M. V. Sivaramakrishnan.

## SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of March 1943, there were six of slight and three of moderate intensities. The details for those shocks are given in the following table:—

| Date | Intensity of shock | Time of origin I.S.T. | Epicentral distance from Bombay | Remarks |
|---|---|---|---|---|
| | | H. M. | (Miles) | |
| 7 | Moderate | 09 32 | 5300 | Epicentra' region near Aleutian Islands. |
| 9 | Moderate | 16 19 | 7870 | Epicentral region near New Zealand (?) |
| 10 | Slight | 14 45 | 7850 | .. |
| 14 | Slight | 18 29 | 4490 | .. |
| 14 | Slight | 19 13 | 4490 | .. |
| 15 | Slight | 08 55 | 7140 | .. |
| 15 | Slight | 11 18 | 4670 | .. |
| 22 | Moderate | 03 06 | 5500 | .. |
| 27 | Slight | 00 08 | 7910 | .. |

## ANNOUNCEMENT

**University of Travancore.**—*The Subramonya Karayalar Lecturership*: Applications are invited for the award of the Subramonya Karayalar Lecturership under the University.

The subject of the Lecture shall relate to some scientific problem of economic value.

The Lecturer selected will have to deliver at Trivandrum a course of not less than four lectures relating to some scientific problem of economic value within the course of two years from the date of this notification.

The Lecturer will be paid an honorarium of Rs. 400 only. A grant not exceeding Rs. 100 may be made by the Syndicate towards incidental expenses in connection with the lectures, if necessary.

Applications must reach the Registrar, University Buildings, Trivandrum, on or before the 1*st July* 1943.

**Imperial Dairy Research Institute.**—The Imperial Dairy Research Institute, Bangalore, has been authorised by the Government of India to entertain Honorary Research Workers, who are graduates of Indian and European Universities and who are desirous of carrying out research work at the Institute. Such candidates as are suitable and well qualified for dealing with a problem within the purview of the work and activities of the Institute will be selected. The number of workers to be admitted will be limited to two at present and their period of research work will not ordinarily exceed one year. The workers will be exempt from payment of any fees for the period of the research work; but they will have to make their own arrangements for board and lodging.

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, No. 4628.

"Biological Reviews," Vol. 18, No. 1.

"Agricultural Gazette of New South Wales," Vol. 54, Pt. 1.

"Biochemical Journal," Vol. 34, No. 12; and Vol. 36, Nos. 7-12.

"Journal of the Indian Chemical Society," Vol. 20, No. 1.

"Indian Farming," Vol. 3, No. 12; and Vol. 4, No. 1.

"Indian Forester," Vol. 69, No. 4.

"Genetics," Vol. 28, No. 1.

"Bulletin of the Indian Central Jute Committee," Vol. 5, No. 12.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 38, Pt. 2.

"Indian Medical Gazette," Vol. 78, No. 3.

"The Review of Applied Mycology," Vol. 21, Nos. 11 and 12.

"Bulletin of the American Meteorological Society," Vol. 23, No. 8.

"Nature," Vol. 150, No. 3815; and Vol. 151, Nos. 3818 and 3819.

"American Museum of Natural History," Vol. 50, No. 3; and Vol. 51, No. 1.

"Canadian Journal of Research," Vol. 20, Nos. 10 and 11.

"Science," Vol. 96, No. 2504.

"Science and Culture," Vol. 8, No. 10.

"Sky," Vol. 2, No. 3.

"Indian Trade Journal," Vol. 148, Nos. 1912-18; and Vol. 149, Nos. 1919-20.

## BOOKS

*The Life of Sir J. J. Thomson.* By Lord Rayleigh. (Cambridge University Press, London), 1942. Pp. x + 299. Price 18*sh.*

*Switchgear Practice.* By Arthur Arnold. (Chapman & Hall, London), 1942. Pp. iv + 238. Price 22*sh.*

*Electric Power System Control,* Vol. XI. By H. P. Young. (Chapman & Hall, London), 1942. Pp. xii + 319. Price 25*sh.*

358-43—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore